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CONTENTS.

EDITORIAL: PAGE.
Paragraphs ... 67
ILLUSTRATED ARTICLES:
Supposed Action of Grounded Railway Currents on Lead Water Pipes ... 68
Electrical Engineering at the University of Pennsylvania, by W. C. Swoope ... 68
Electrical Work on the World's Fair Grounds ... 69
Notes on the Feeding of Arc Lamp Carbons by an Electric Heat Movement, by S. E. Nutting ... 70
Plant of the People's Electric Light and Power Company at Oswego, N. Y ... 71
The Storage Battery and Car of the Ford-Washburn Storelectro Company ... 72
Test of the Neversink Mountain Electric Road.—X., by Hermann S. Hering and Wm. S. Aldrich ... 73
The Sturtevant Automatic Double Inclosed Engine ... 77
Hand Power Wheel Press for Electric Railroad Work ... 77
The Cochrane Separator ... 77
The Standard Fan, Motor and Battery ... 77
Robertson's Condenser and Exhaust Pipe Head ... 77
Device to Prevent Belt Slipping ... 78
The Franklin Electric Company's Storage Battery ... 78
The Nassau Electrical Gas Lighter ... 78
MISCELLANEOUS:
American Street Railway Association ... 69
New York State Railway Association ... 71
Moonlight Tables for August, 1892 ... 71
The Length of Submarine Cables ... 71
Electro-Metallurgy.—VII., by F. M. F. Cazin ... 75
Thomson's Law of Economy, by E. J. Carter ... 75
New Books ... 76
Long Distance Power Transmission ... 76
The Annual Clam Bake of the American Electrical Works ... 78
FINANCIAL INTELLIGENCE: The Electrical Stock Market, 79; New Incorporations, 79; Affairs of the Companies, 79.
SPECIAL CORRESPONDENCE: New York Notes, 80; New England Notes, 80; Western Notes, 80; Canadian Notes, 80.
NEWS OF THE WEEK: The Telephone, 80; The Electric Light, 80; The Electric Railway, 81; Legal Notes, 81; Personals, 81; Miscellaneous Notes, 81. Inquiries from Correspondents, 81; Answers to Correspondents, 81
INDUSTRIAL AND TRADE NOTES ... 81
BUSINESS NOTICES ... 81
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 82

Thomson's Law. THE law formulated by Lord Kelvin governing the choice of the proper size of wire for any given electric installation is well recognized in electrical engineering practice; but its applicability to the selection of the proper kind of apparatus for every part of a central station equipment, from the furnace door to the lamp or the motor, is not so generally recognized. Attention is called to this fact in an article, which we print elsewhere in this issue, showing the general application of the principle in the case of central station design. Indeed, it might almost be said that the application of this law is the most important business of the electrical engineer, since by its misuse or by an entire disregard of it any plant may easily be made so uneconomical that dividends on the investment will be an impossibility.

Electrical Railroading on a Large Scale. FROM apparently authentic sources a rumor reached our office that there is in this country in course of consideration, an electric scheme involving a capacity of 100,000 h. p. More than this we have not been able to learn at present writing. It is not known whether it is urban or interurban; if the former it may possibly mean the combined roads of Philadelphia, with its 510 miles of street railways, where after a desperate fight for the trolley privileges, the railroad magnates are reported to have conceded to the wishes of the people and have obtained control of the conduit road used in Chicago, which we described in a recent issue. It is not unlikely, however, that this huge plant about which rumors are afloat may possibly be an interurban road to replace a steam railroad. Announcements of such projects are often made in the daily papers and refuted again in the next issue, but the present statement comes from personal sources which we have reason to think are reliable, although we do not vouch for its correctness. We hope the rumors are true, and extend our hearty wishes of success to the promoters of what will be by far the largest electric installation ever projected. The total capacity of the West End Electric Railway system, which is at present said to be the largest, is scarcely more than a quarter or at most a third as large.

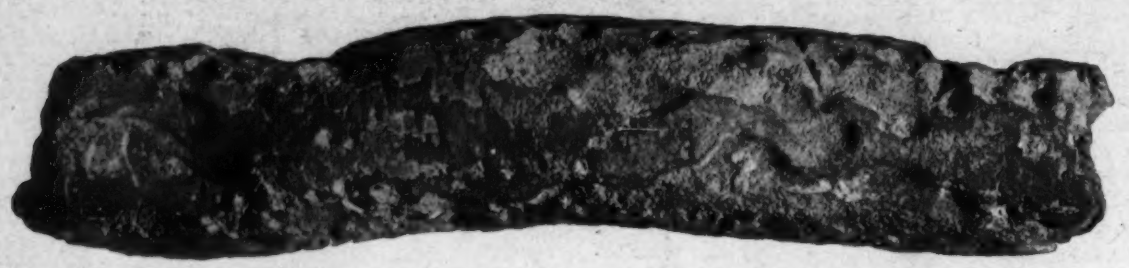
Wanted: A Reliable Turbine Regulator. USUALLY we have the pleasure to announce in these columns that such and such an important invention or discovery has been made. In the present case, however, we must reverse the usual system and call the attention of inventors to the apparent absence of an important invention. The matter has been brought to our attention so forcibly by a number of parties, that it was thought best to show electricians who were interested the importance of giving their attention to this field with the hope that possibly by means of some electrical device something may be accomplished. The invention wanted is a good reliable automatic regulator for a turbine or other water wheel, which will meet the requirements of electric lighting plants. Mechanical engineers seem to have failed to devise such a regulator; perhaps electrical engineers will be able to do better. The difficulty seems to be that the regulators are too sluggish in their action to suit the requirements for an electrical installation; for rapidly varying loads, as, for instance, in electric railroading, the regulation sometimes lags behind the load by what might be called a whole wave length, opening the gates after the excessive load has again diminished, thereby making matters worse. The trouble does not seem to lie in the sensitiveness of the speed detector, but more in the heavy, sluggish apparatus for manipulating the gates under pressure. The requirements of constant speed, made by electrical engineers for their plants, exceeded so much those which were customary before, that the introduction of electric lighting has brought about considerable improvement in steam engine regulation. With the rapidly increasing use of water power for electric plants the same want, not felt heretofore, now makes itself evident and will, it is hoped, have an equally good effect in hydraulic engineering as it did in steam engineering. The effects of poor regulation were forcibly brought out in our serial on the Neversink Mountain road. It would be interesting to hear the experience in other plants, as well as that of the turbine makers, who doubtless claim that they can do better.

One of the Results of Fame. AT comparatively regular periods the daily papers appear with some astounding prophecy or statement purporting to come from Mr. Thomas A. Edison. Sometimes, we do not doubt that there is no foundation whatsoever to these newspaper fabrications, or that the facts are distorted so that the germ of truth in them is completely lost. More often, however, they doubtless have their origin in some statement actually coming from Mr. Edison, but with the formidable tool known as the newspaper man's license they are transformed at each transmission from one paper to another until they come back so changed that it is hard to trace their true origin. By many people Mr. Edison is thought to have been the inventor of the electric light, and for a time the incandescent lamp was often known as "the Edison light" in distinction from "the other kind," meaning the arc, which was not the Edison light. To these people there is nothing too wonderful and startling for Mr. Edison to do, and if he says he can do it, that is sufficient; they believe it just as it appears in the papers. Sometimes much mischief is done by such statements, as was shown some time ago, when a scheme credited to Edison was suddenly sprung upon the innocent public, to the effect that the whole system of electric railroading was to be revised by a new invention of Edison's. The consequence was that the electric railway business was seriously checked—managers said they would wait for Edison's new discovery, and this continued for some time, until the bubble burst. One of the good effects left by it was that people will hereafter place less confidence in such statements. It is a pity that they are generally made to the daily papers first instead of to the electrical journals, and they are, therefore, often dangerous, while, judging from the past, they are probably harmless. The latest startling Edison story comes from Paris. An excitable Frenchman reports that he saw a statement that Edison had sold to the German government an electrical infernal machine which he was building for the German Emperor, that would destroy the largest cities from a distance of 30 miles and which would annihilate a whole army corp. The Frenchman innocently believed it all, and wrote to Mr. Edison asking whether he would really place his scientific genius at the service of despotism as against liberty, to which Mr. Edison replied that he would not, adding furthermore that the story was wholly false. The story which so excited the Frenchman is thought to have been originally based on the statement said to have been made by Edison at a time when war was threatened between this country and Chili, in which he suggested that streams of water conveying a current of electricity could be thrown on the ships of the enemy to their great discomfiture. Just how he proposed to do this was not stated.

Electricity the Supposed Mischief Maker Again. ANOTHER case has been brought to our notice in which serious mischief was done by some unknown mysterious intruder, and as electric sparks were seen near the places where the damage was done, electricity was, of course, credited as the cause. It is not unlikely, however, that this time, as a great exception, the man who is always ready to attribute any mischief to electricity has, by sheer chance, been correct in his prophecy. This was not surprising, for, according to the law of probabilities, if all danger done, no matter what it is, is on general principles always attributed to electricity (which we admit is among the long list of mischief makers), then sometimes the guess must turn out to be correct, but the guesser in that case does not necessarily deserve any credit unless by chance he really did know what he was talking about. The case was as follows: In a certain place, underground lead pipes used for water service were found to break down frequently without any apparent cause; on examining the pipe, of which we show a view in another column, it was found to be very badly corroded, looking almost as if the rats had gnawed it. The soil was analyzed by a chemist, but no direct cause could be found in the constituents of the earth; as the pipe ran parallel to the electric railway, it was concluded that electricity did it. Before admitting definitely that it did, it would be necessary to have further details than those which we have received. But let us assume that the following was the case, all of which appears likely from the facts received: that the pipe ran parallel to the electric railway; that a ground return was used; that chlorides of magnesium and calcium were contained in the soil; perhaps, also, that the bonding of the track was inadequate, or perhaps very imperfect. These conditions are sufficient to cause a shunted current to pass through a neighboring parallel-running lead pipe, which is by far a better conductor than the soil itself, unless the latter is very moist, as the current must pass from the ground to the lead (or vice versa) and as most ground conducts by virtue of its moisture, there should be according to the well known laws, electrolytic action on the outside of the pipe. This action might be greater with a positive than a negative current, but under certain conditions even a negative current will corrode lead instead of cleaning it as usual. It therefore is not essential that the ground current be positive. Nor is it essential that the lead pipe runs parallel to the track, for it might have run so as to act as a shunt to a loop, in which case the action would have been all the greater. It is claimed by some that the earth return current does not necessarily flow through the ground back to the source, but that it is diffused, as it were, in the ground; even admitting this, the lead pipe would be likely to act as a diffuser or equalizer, as it is well known that the ground itself is not the best kind of conductor unless very moist, while lead pipe, owing to the intricate metallic network with which it is connected, as well as to the water circulating through it, would act as an excellent diffuser. Railway currents are often very great in quantity and a comparatively small portion shunted off into a lead pipe might in time do much mischief electrolytically. Chlorine is one of the worst elements to have in a lead storage battery as it makes what in common parlance is termed "a bad white mess" of both the plates. As its presence in the soil was shown by the chemist, it is not unlikely that it shares the blame, especially as it would require but a comparatively small current to produce very decided effects on the lead pipe. It is also likely that this action would be concentrated where the salts are most abundant, and may possibly not exist at all, when such salts are not present. A further investigation intelligently made by unbiased parties might give results which are very instructive, besides being interesting. If the cause is really attributable to the grounded current, it is simply another case which shows the numerous snags into which one runs by using the earth as part of a circuit. It would also be a more serious objection to grounded railway circuits than their effect on the telephone lines, which can readily be avoided by using metallic circuits for the latter. Water pipes cannot well be insulated or protected electrically in any other way. Our object in mentioning this case is, that if electricity is really the cause, the sooner it is definitely known the better, in order that some provision be made to avoid repetition, as the general destruction of water pipes in a city would be a very serious matter. Trolley roads are already blamed for enough mischief, and it is therefore the wisest policy in the end to find out definitely whether this is a valid cause for complaint or not, and if so, to find the remedy and then to apply it conscientiously. Even though it may cost something it will doubtless be the best in the end. The ears of the opponents of the trolley system are wide open, taking in all such rumors. According to the old saying, "in times of peace prepare for war," the question ought to be definitely settled as soon as possible, and if these complaints should be well founded a remedy ought to be found.

Supposed Action of Grounded Railway Currents on Lead Water Pipes.

In a number of Western cities it was noticed lately that some lead water pipes laid in the ground were breaking down faster than they ought to, thereby causing considerable trouble. In one case in the city of Saginaw, Mich., the lead pipe which was giving trouble was taken up and found to be badly corroded. A portion of the pipe is shown in the accompanying cut, which is a full size reproduction of the original piece sent us. It will be noticed from this that the corroding action appears to have been chemical in its nature, and that it seems to have been quite powerful and irregular, penetrating deeply in some places and not at all in others. In places where there had been no action the pipe, as it reached us, was partially covered with some black substance resembling black varnish, which had evidently protected the lead under it from the corroding action. The compound into which the lead had been changed had all been washed off on the fragment sent us, and we therefore could not make any examination of its nature.



LEAD PIPE SAID TO HAVE BEEN DAMAGED BY THE ELECTRIC CURRENT.

An investigation was made to ascertain the cause of the trouble and at first it seemed impossible to trace it. A chemist analyzed the soil and made other chemical tests. He found that the soil was of the usual nature, with the exception that it contained chlorides of magnesium and calcium, but said that he could not find anything in the soil that would in any way cause the lead pipe to show the pitted appearance as seen on this fragment.

It was finally suggested by some one that as this lead pipe ran parallel with the electric railway, the corrosion may have been due to the "sparks that flashed from the rail through the earth to the lead pipe." Without indorsing this statement as it is given, it appears likely from the scant information at hand that there is some truth in the belief that the earth return currents were the cause, though no definite statement to this effect can be made without having further data as to the conditions.

The appearance of the corroded spots is not as if the lead had been burned out, but is precisely like a certain corrosion which takes place on lead storage battery plates under certain abnormal conditions. It is, therefore, probably chemical in its nature, caused by the electrolytic action of the ground return currents from the railway, stimulated by the presence of certain mineral salts in the soil. Additional data, however, is necessary before the cause can be definitely attributed to these currents. We allude further to this in our editorial columns.

Electrical Engineering at the University of Pennsylvania.

BY C. W. SWOOPE.

It is fitting at the close of another academic year to give some account of the course in electrical engineering at the University of Pennsylvania, as well as some information concerning the new and important additions to the mechanical and electrical engineering departments, now in progression and expected to be completed by the beginning of the fall term.

Some of our leading electrical authorities have stated that electrical engineering is a branch of the mechanical, or an electrical engineer is a mechanical engineer with a theoretical and practical knowledge of electricity and its applications. In accordance with this view the University, as well as our other colleges, requires electrical engineering students to take the greater portion of the mechanical engineering course, which is designed to give students a knowledge of the practical methods of procedure as exhaustive as a University can make them and a thorough training in the principles underlying the different divisions of the profession. There are practically two courses of instruction open to students in this work. One of these courses has been established for a number of years, and is only open to students who have taken the first two years of the Towne Scientific School, or who come prepared to pass examinations on the work of these two years, the course extending over three years. The other course extends over four years, and admits students after examination on the subjects usually required for admission to college. The studies taken in the course bear directly on the work of the engineer. At the end of the second year the studies are differentiated somewhat, for those students taking the electrical engineering course. The instruction in mathematics extends through three years. Higher algebra, plain and spherical trigonometry are taught in the freshman year. In the sophomore year, in addition to the course in analytical and descriptive geometry, a thorough course in elementary and differential calculus is given, extending also through the junior year. The course in physics begins with recitations in mechanics, which are followed by illustrated lectures and recitations on sound, light, heat, electricity and magnetism. One year is devoted to practical physics and to exercises in the physical laboratory, in which the student carries out practical work with physical apparatus, and is taught the best methods of physical experimentation. This course is of special importance to students in electrical engineering, as it gives the necessary training for advanced work in the electrical laboratories. Special attention is given to the subject of mechanical drawing, one which enters so largely into the work of the engineer in designing, construction, etc. Geometrical construction, projections, free hand work, shades and shadows, form the foundation work; sketches from machinery in the laboratories and original designing complete the course.

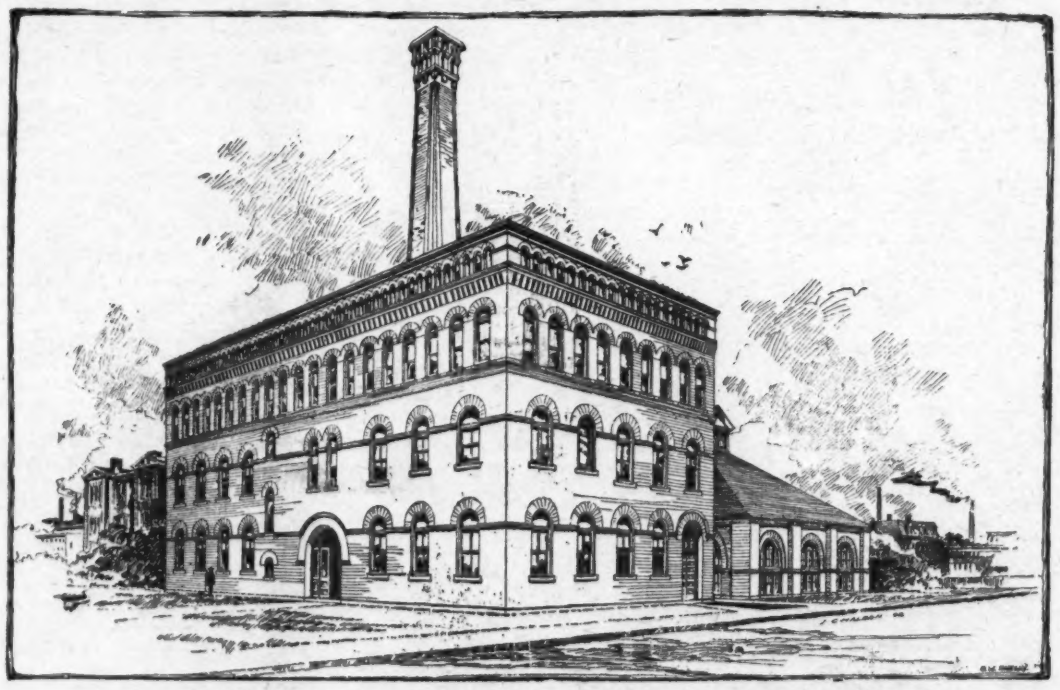
The course in applied mechanics is studied in detail, and presented under the following heads: Graphical statics, graphical study of stresses and strains in structures, statics, mechanics and strength of materials, hydrostatics, and hydraulics, kinematics, principles of the combinations of mechanisms, hydrodynamics, study of fluid friction, turbines, etc. The steam engine, the latter being one of the most important subjects, considerable time is given to its study, including valve gears, engine design, steam boilers, thermodynamics and marine engineering. The steam laboratory has been newly fitted with a complete set of apparatus for carrying out tests in steam engineering. A new steel boiler has been added, 25 horse-power capacity, and fitted for making tests, water being drawn from tanks through meters. Two engines are connected to the boiler, one a 10 × 24 Hamilton Corliss and especially fitted for tests. The department is well supplied with indicators, tachometers, planimeters, special gauges and all apparatus necessary for carrying out the various mechanical tests. A standard oil-testing machine is used for carrying out tests upon oils, and a 50,000-pound testing machine is used for experimental purposes. Wood and metal shops are fitted up with lathes, dull press planers, etc., electrical students taking the regular shop practice in manual training.

The work devoted especially to the subject of electricity begins in the junior year with a discussion of quantity, potential, current, resistance, electrostatic measurement, magnetism and magnetic measurement, electromagnetic measurement, and the units adopted in practice. The course then treats of the measurement of currents, difference of potential, construction and calibration of ammeters, voltmeters and galvanometers, a study of primary and secondary batteries, measurement of insulation and the apparatus used therein, measurement and comparison of magnetic fields, the theory and design of dynamos and motors, as well as the measurement of efficiency and characteristics of the various types. Lectures are given on the practical systems of arc and incandescent lighting; generation, transformation and distribution of electrical power; wiring and construction work, and upon the care and management of accumulators. The telephone and telegraph, including under the latter the principles of single transmission, forms of sounders, relays and keys, open and closed circuit working, duplex, quadruplex and harmonic telegraphy, and the use of dynamos in telegraphy, are also considered.

The course in the laboratory covers the use of all test apparatus for measuring currents, resistances, insulation and capacity, the testing of dynamos and motors, storage batteries and commercial ammeters and voltmeters. The apparatus in the department is being rapidly increased and now contains Edelmann, Hartman, Thomson, d'Arsonval and standard tangent galvanometers, Wheatstone bridge sets, rheostats, condensers, special electrolytic cells, Bunsen photometer for arc and incandescent work. Four dynamos of the Edison, Weston, Hering and Gramme types and one Jenney motor are used for experimental tests, etc.

The department of mechanical engineering was established some sixteen years ago, the electrical more recently. They have grown slowly and steadily until within the past three years when the number of students began to increase rapidly; facilities were provided, but in the last year the numbers have still further increased until the department was hampered for room and apparatus. With characteristic energy the trustees determined to meet this need as well as one for improving the heating, lighting and ventilation of existing buildings and providing for new additions. The grounds of the University cover an area of over forty acres, upon which are located fifteen separate buildings, each having its own steam heating plant and lighted by gas. To heat all these buildings a 1,200-h. p. central station is now under course of erection; in addition all the buildings are to be lighted by electricity and thoroughly ventilated by the use of fans located in each basement and driven by electric motors. The entire plant is to be put in, not only for supplying light and heat in the most economical manner, but is especially designed for the purpose of instruction, for which at all times it will be available.

The boiler house will be 100 × 50 feet isolated from the engineering building, and will contain examples of Galloway, return, tubular and sectional boilers, generating steam at 100 pounds for engines in the dynamo room. These boilers are intended to present to the students the best examples of modern stationary practice, and will be so equipped that the values of different methods of burning coal can be experimented on under the conditions actually found in a commercial plant, provision being made in the most improved and convenient manner for ash vaults, coal bins, weighing scales, etc. The exhaust steam from the electric light plant will be utilized for steam heating. The Holly system of piping is to be used, and, owing to the configuration of the land, it is possible to get a gravity return of the water from the condensed steam in the various buildings to wells in the boiler house, from which it may be pumped into boilers. A short distance from the boiler-house is the engineering laboratory, in the basement of which is located the dynamo and engine room. Two 100-h. p. compound engines and two similar to the high speed Porter-Allen, as well as a 30-h. p. Corliss now in the college, will be used. The electric lighting plant will be partly on the alternating and partly on the direct current system. Two 500-light 1,000-volt alternating and four 500-light direct current dynamos are to be employed, 3,000-light in all. As with the boilers and engines, it is proposed to use several types of American dynamos.



NEW LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

The alternators will be connected to a separate switchboard, and so arranged to run singly, parallel or as motors; the direct current machines will be compounded, but so connected that by throwing switches they will become shunt machines. One alternator and one direct current machine will be belted to each of the compound engines, and the remaining dynamos to their separate engines. The plant, in addition to machines and apparatus already belonging to the department, and including the motors used in ventilation, will be larger and more comprehensive than that of any other institution in the country. Everything has been planned, not only to be commercially a successful plant, but to give the largest amount of opportunities for the students to study the peculiarities and test the efficiencies of the best types of engines and dynamos.

On the second floor will be located the mechanical labor-

atory, and upon the floor above the drawing room, electrical laboratory and photometric room. The laboratory will occupy 1,600 square feet of space. A switchboard will be located here for connecting the various dynamos to instruments or with each other, etc., for testing purposes. All main feeders, alternating and direct current from the dynamo room to the buildings will be placed under ground. The plant, when completed, will be under the immediate charge of a superintendent, to whom the officers of the department will act as supervising and consulting engineers.

It is believed when the above plans are carried out that the University of Pennsylvania, as regards its mechanical and electrical engineering, will take front rank among educational institutions for the completeness of equipment and facilities for instruction in these branches.

Electrical Work on the World's Fair Grounds.

No one can visit the grounds set apart for the Columbian Exposition, at Chicago, without being amazed at the extent and character of the work that has already been done in preparing for the exhibit of next year. Although only a few months have passed since ground was broken, many of the buildings are well along toward completion, and the entire system of structures is rapidly assuming an appearance of stability and finish that does great credit to the constructors, and that is a surprise to all who have not been on the ground to watch the progress of the work from day to day.

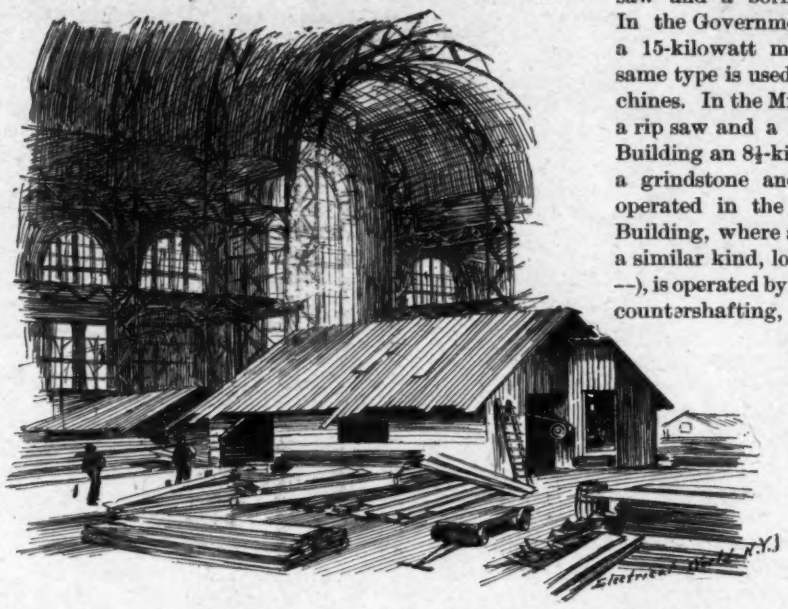


FIG. 1.—INTERIOR VIEW OF ELECTRICITY BUILDING.

In a recent issue of THE ELECTRICAL WORLD we took occasion to present to our readers an illustrated description of the conduit that has been constructed to carry the wire underground from the power station to the various buildings, and also to show an illustration of one of the electric launches that have been built to ply about the extensive lagoons of the Park. Some additional illustrations are here given of sketches made by our artist while on a recent visit to the grounds, showing the appearance of the Electricity Building at that particular time. Some sketches are also shown of the uses that are made of electric power for hoisting and saw-mill purposes on various parts of the grounds.

Figs. 2 and 3 show views of the Electricity Building, which would have been difficult to secure by photographs.

FIG. 2.—EXTERIOR VIEW OF ELECTRICITY BUILDING.

Fig. 2 shows the inspection train of the American Institute of Electrical Engineers passing the end of the building and approaching the bridge over the lagoon. Fig. 3 is a sketch of the building as seen from the opposite side of the lagoon.

Fig. 1 shows a sketch made on the interior of the Electricity Building, showing the state of the construction of the roof, and giving as well a general view of an electric saw mill that the contractors have in operation in the centre of the building. This mill is only one of a number of similar ones used in the various buildings on the grounds, current being supplied from the circuits of the Exposition temporary plant.

Fig. 5 is a view of one of the hoists used in raising the heavy columns and trusses that are placed in the walls and roof of the Agricultural Building. The motor and hoist are placed in a temporary and movable house from which the rope is run to the distant parts of the building wherever the derrick is used upon the work. The motors used on these hoists, as in the sawmills, are of the Edison type.

The generating plant that furnishes current to all of the machines on the grounds consists of two 100-kilowatt compound wound Edison dynamos of the type that has been used by the company in its street railway generating stations since 1888. Two high speed engines are belted direct to these machines, and the speed is such as to give an average electromotive force of 500 volts. The plant is so arranged that the two halves of it are entirely distinct and in case of breakdown either section is sufficient to furnish all the power called for until repairs can be made.

The saw mill in the Liberal Arts Building is operated by a 12-kilowatt Edison shunt wound motor, driving by means of countershafting a band and cut-off saw, a rip saw and a boring machine. In the Government Building a 15-kilowatt motor of the same type is used to drive cut-off, rip saw and boring machines. In the Mining Building a 6-kilowatt machine drives a rip saw and a grinding machine. In the Horticultural Building an 8¼-kilowatt motor runs a cut-off saw, a rip saw, a grindstone and a boring machine. Another saw mill operated in the same way is seen in the Transportation Building, where a 12-kilowatt motor is in use. The plant of a similar kind, located in the Electricity Building (see Fig. --), is operated by a 12-kilowatt Edison motor, which through countershafting, is connected to band, cut-off and rip saws.

A number of other saw-mill installations may be seen in operation on various parts of the grounds, but they are all of the same general character as those described above.

The hoisting plant shown in Figs. 4 and 5 is typical of a number of installations that may be found in the different buildings now in process of construction. The motor employed is a 20-kilowatt Edison shunt wound machine having a common base with the hoist and geared to it by a rawhide pinion on the armature shaft. The hoist, shown separately in Fig. 4, is of the double drum form with two winch heads, and was manufactured by the American Manufacturing Company, of St. Paul, Minn.

In some of these hoists used on the grounds two weights may be raised at the same time and the winch heads can simultaneously be used to bring heavy pieces of material into the position necessary before hoisting. The speed of the motor is uniform, while the drum speed can be doubled by a second gear at the back of the machine. It was said by those in charge of the machines that they had been found amply sufficient for the needs of the work and that the heaviest material used could be raised with the greatest ease. In some of the hoisting plants the motor is mounted upon the same base as the derrick and is movable with it.

Another application of electricity that is of interest to electrical engineers is the operation of an automatic pulverizer made by Raymond Brothers. The motor used to drive this pulverizer is a 12-kilowatt Edison shunt wound machine, which is coupled direct to the pulverizer. The speed at which it is driven is about 1,200 revolutions per minute. This machine is used for molding clay, for pulverizing and for similar work.

In all of the plants described above the motors are provided with an ordinary switch and rheostat and main line switches connected in series with the different machines. As far as possible the motors are inclosed in temporary houses built for the purpose, to protect the apparatus from accidental injury or damage by the weather. The territory covered by the distribution system for these isolated motor plants is not far from one mile long by three-quarters of a mile wide. The entire plant is operated under a lease granted by the Edison General Electric Company. This lease will expire in January, 1893, and it is stipulated that the plant is to be returned to the Edison company by that time in good order.

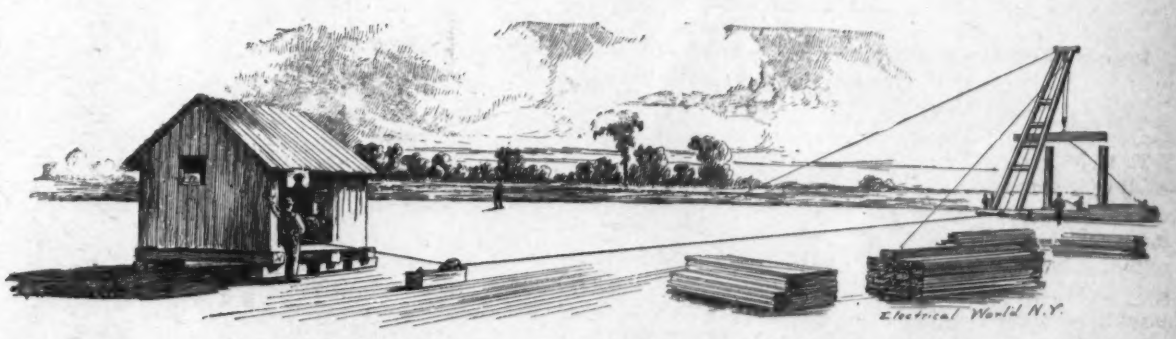


FIG. 5.—ELECTRIC HOIST USED ON THE WORLD'S FAIR GROUNDS.

Regarding the general appearance of the finished structures on the exposition grounds it may be said that nearly every visitor is astonished at the solidity and handsome exterior which the constructors have been able to give to the various buildings with what is in reality a material that is far from possessing a solid or substantial character. As a general rule visitors are agreeably surprised to find that

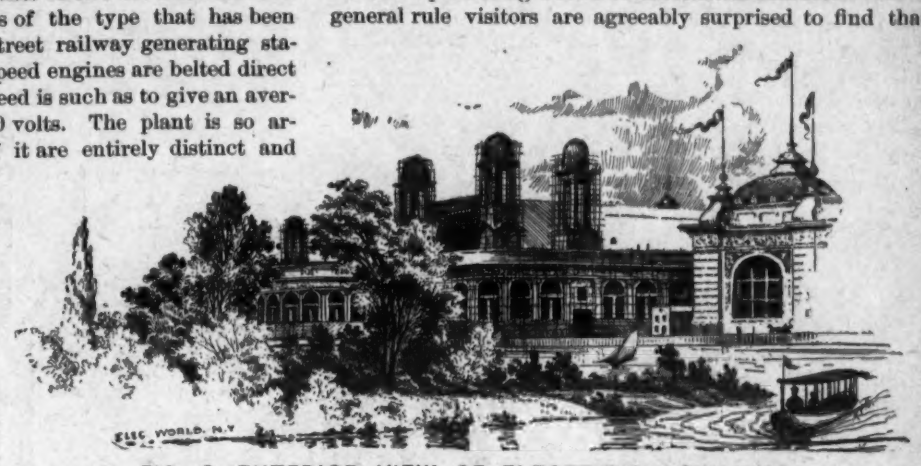


FIG. 3.—EXTERIOR VIEW OF ELECTRICITY BUILDING.

there is such an excellent prospect of a successful exhibit, after being made to believe by the newspaper reports that the management of the Fair was so imperfect as to make it practically impossible to present a creditable exhibition in so short a time.

American Street Railway Association.

The eleventh annual convention of the American Street Railway Association, which is to be held at Cleveland, O., Oct. 19, 20 and 21, promises to be the largest and most important one ever held. It is hoped that every company in the country will be represented there. An interesting programme has been prepared and will be thoroughly discussed. In order that the delegates and others who expect to attend may be properly accommodated they are requested to notify Mr. H. J. Davies, secretary of the local committee, Cleveland, at the earliest possible date. The following are the subjects for discussion and the committees appointed to report thereon: "Power House Engines"—T. W. Wrenne, president United Electric Railway, Nashville, Tennessee; L. H. McIntire, engineer, Harlem Bridge, M. & F. Railway, New York; F. S. Pearson, chief engineer, Electrical Department West End Street Railway, Boston. "Relative Cost of Operation of Horse, Cable and Electric Roads"—Wm. McC. Ramsey, electrical superintendent Federal St. & P. V. Passenger Railway, Pittsburgh, Pa.; F. R. Greene, secretary Chicago City Railway Company, Chicago; John L. Heins, superintendent Brooklyn City & Newtown Railroad, Brooklyn. "Standards for Electric Railways."—O. T. Crosby, Utica, N. Y.; H. I. Bettis, general manager Atlanta Consolidated Railway, Atlanta, Ga.; E. E. Higgins, general manager Short Electric Railway Company, Cleveland; Chas. W. Wason, vice-president East Cleveland Railway Company, Cleveland; J. E. Rugg, superintendent Citizens' Traction Company, Pittsburgh. "Form for Street Railway Electrical Statistics."—Thos. H. McLean, secretary Twenty-third Street Railway, New York; Henry W. Watson, President Buffalo City Railway Company, Buffalo; Charles E. Warren, New York. "A Model Electric Street Railway Roadbed and Underground Wiring."—Geo. W. Baumhoff, superintendent Lindell Railway Company, St. Louis. "A Perfect Overhead Construction."—Chas. H. Smith, general superintendent Troy & Lansingburg Railway, Troy, N. Y. "Economy of Machine Shops for Electric Street Railways."—J. H. Bickford, Salem, Mass.

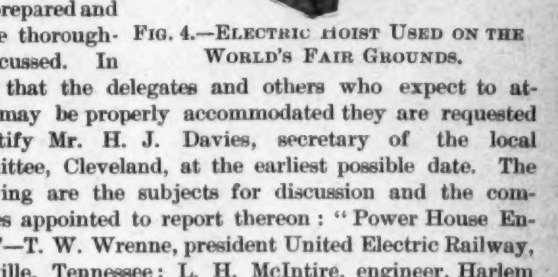


FIG. 4.—ELECTRIC HOIST USED ON THE WORLD'S FAIR GROUNDS.

Notes on the Feeding of Arc Lamp Carbons by an Electric Heat Movement.

BY SAMUEL E. NUTTING.

Maintaining a uniform length of arc in an arc lamp while the carbons are being burned away has called forth an amount of ingenuity hardly equaled in any of the branches of the application of electricity to the use of man. To the casual observer this may appear strange, but to those who have attempted to accomplish this result the truth of the assertion will be apparent. In the first place, the feeding forward of the carbon must be automatic, and must depend upon the length of the arc itself. Now, what is there about an arc at various lengths that can be got hold of by any means and made to cause the feed mechanism to act? We find that the heat effect and the light effect both increase and decrease with the length of the arc, but in what kind of a way can we make either of them do the work? Heat will expand most substances, and will also melt or burn up almost anything, but how can such expansion, melting or burning up be made to cause a movement of the carbons? No way has yet been found practical enough to depend upon. As for light, there is no way of converting its energy into a movement capable of operating anything. The feeble movement of the vanes of a radiometer is the only known motion from light that is directly perceptible.

The resistance of the arc to the action of the current we find also varies with its length, and in this fact lies the only available means of automatically causing a movement of the carbon to take place. In some forms of lamps, working singly upon the circuit of a generator, this increased resistance of the arc causes a decrease of current by which usually, by means of an electromagnet in the main circuit, the carbon is retarded and allowed to move forward by its own weight, but when the current in the circuit is maintained constant without regard to the resistance of the circuit, each lamp, whether one or more, must be made individually responsible to its own arc, or, in other words, each arc must take care of its own feed mechanism independent of the current or other lamps in circuit. This is done invariably by providing a path through the lamp other than through the carbons, by which the mechanism is caused to shorten the arc by allowing the carbons to move forward. This shunt, as it is called, is made of so high a resistance in all cases as to allow but a very small portion of the current to pass, but sufficient to make quite a strong magnet when formed of as small a copper wire as can safely carry it. The strength of the current in this shunt at all times, according to Ohm's law, depends upon the apparent resistance of the other path through the lamp which traverses the arc, increasing as it grows long and decreasing as it grows short, *i. e.*, it varies directly as the length of arc. This, as mentioned before, furnishes the only practically available means of making an arc take care of itself.

Many ways have been devised for making this variation of current through the shunt operate to control the movement of the carbon, most of them making the shunt of a long, thin copper wire, and coiling it about an iron core in the form of an electromagnet. This magnet increases and decreases in strength with the current in the wire, operating some device or other for releasing the carbon and allowing it to move forward by its own weight, together with the weight of its holding rod. These devices employ either a direct clamp or clutch upon the carbon holding rod, or an indirect catching and releasing of the rod through a train of gear wheels or clockwork. In all these various methods employing the shunt as an electromagnet, the movement of the carbon is necessarily intermittent, starting only when the magnetism in the shunt coil reaches its maximum, and stopping when it has become weakened by the shortening of the arc. A succession of these intermittent movements keeps the length of arc within certain limits, according to the delicacy and sensitiveness of the moving parts. All movements involve friction, and this friction, whatever it may amount to, is an uncertain and variable element. Moreover, all friction is a drag, both ways, on the movement; consequently there must be a discrepancy between the force involved in the magnet and the consequent movement. Any increase of friction from dirt, rust or rusting of the parts interferes with the closeness with which the lamp maintains its arc at a certain length.

The character and peculiarity of the resistance of an arc between two carbons is important and worth noticing in this connection. Two carbons in contact with a current passing through them and gradually drawn apart will show, by a voltmeter attached to their terminals, only a slight resistance at first, which gradually and rapidly increases to a point where the hissing noise stops, when the meter jumps suddenly, increasing about 25 per cent. (on a ten ampère current), and then goes on gradually and uniformly increasing from point to point as long as the arc can be maintained steady. This decided change in the resistance of the arc at the point where the hissing sound ceases is of great service in the operation of arc lamps of all kinds, as it forms a practically impassable barrier to the length of arc. In low tension or short arc lamps it forms the upper limit to the length of arc, and in the high tension or long arc the lower limit. Any lamp mechanism that will not work with this decided change in the resistance of its arc cannot be depended on to work at all.

It is evident that the ideal arc would be one maintained constantly at a certain length, its mechanism keeping its carbon moving forward constantly at the exact rate that they were consumed. This has been the aim, no doubt, of every one who has attempted to build a lamp on fundamental principles. Few devices, however, are on record capable of more than approximately accomplishing this object, and most of these are impracticable, owing either to their unstableness or to their complex and expensive construction.

It is very desirable to have a continuous movement for an arc lamp instead of the usual intermittent one, that is, one that would take care of the arc and keep it constant in length without the use of magnetism, pulleys, gearing, springs and levers, which necessarily involve that uncertain

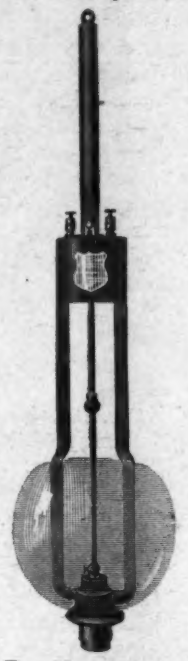


Fig. 1.—The Nutting Arc Lamp.

element, friction. It had been known for years that a wire could be heated by a current of electricity; it was also well known that a hot wire would melt its way through a piece of wax when pressed against it. By trying I found that a wire kept hot by a current would pass continuously through a sheet of wax, and, moreover, that the melted wax could be made to flow back and fill the space cut through by the wire and again solidify without disturbing the strength or solidity of the cake. These facts seemed to point out a way to make a continuous movement for an arc lamp, providing the melting could be done by a small enough current in a high resistance shunt around the arc, and providing the variation of heat responded quickly enough to the changes in current of the shunt.

To make these facts of practical use it was necessary to

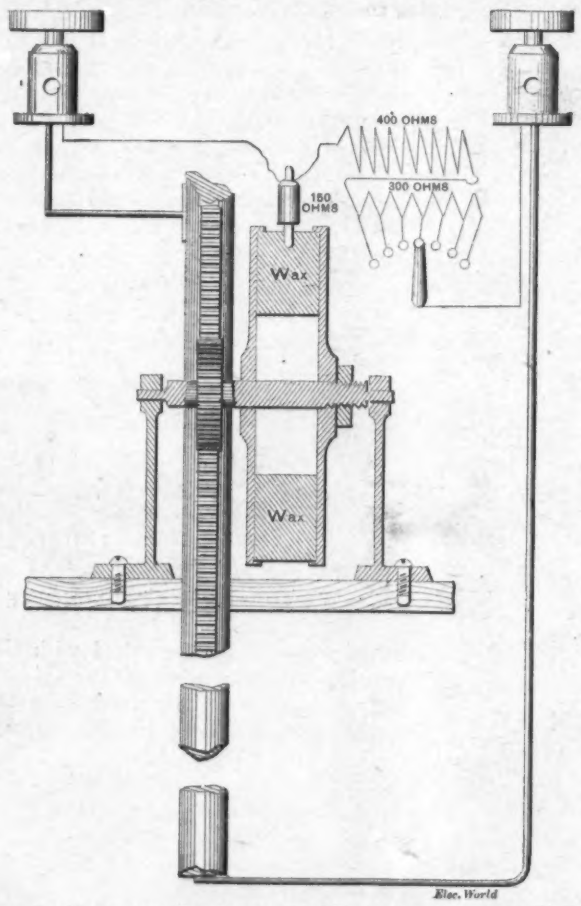


Fig. 2.—Diagram Showing the Operation of the Nutting Arc Lamp.

find out a number of things by experiment. The first experiments were made with a long stick of paraffin wax, held perpendicular and resting upon a piece of German silver wire passed directly through it. It was found that when a sufficient current was passed through the German silver wire the wax began to melt, flow past below the wire and harden again. By means of a rheostat placed in series with the wire, by which the current could be varied, it was found that the rate of melting varied decidedly with a variation of the current.

The next step was to make a disc of the same material and pivot it upon a shaft passed through its centre. A short piece of graphite from a lead pencil was passed through the disc near the outside edge and supported upon posts at each side; a weight was suspended from the shaft by a string wound thereon, and the thing was ready to rotate as soon as the graphite pin would allow. This pin was connected up in circuit through the posts that supported it, and, with less than an ampère of current began to melt its way through the wax and allow it to rotate. The wax flowed back into the groove behind the pin, and hardened fairly well, but the paraffine had the peculiarity of softening for some distance around the melted portion allowing the heated pin to be pressed into it by the weight before being fairly melted. This paraffine disc was replaced by one of the same size and shape made of stearine, which overcame the difficulty entirely, the stearine having a very decided melting point, and remaining hard and solid close up to the melted portion more like ice. This disc was allowed to rotate many times, the pin melting its way in the same path over and over again. A long pointer was fixed to one end of the shaft so as to rotate with it and magnify the movement of the disc. By this means the starting, stopping and various rates of movement could be plainly seen. It was astonishing how suddenly the movement would stop when the current ceased, and how wonderfully sensitive it was to variations of the current. By carefully noting the time, the distance traveled by the pointer and the strength of current passing it was proven beyond a doubt that this melting effect, or progressive movement, produced by a current passing through this constant resistance, increased and decreased as the square of the current, which accounted for the wonderful sensitiveness of the movement to variations of current.

In this arrangement there was some tendency in the melted stearine to creep out on the pin away from the disc and be lost. To obviate this the disc was replaced on the shaft by a cylinder and a looped wire dipped down into it from the top. This loop was made a part of the circuit and held fixed in place over the cylinder. This worked better, but disturbed the wax somewhat more than the straight pin.

The next question was how to make so small a current as should be shunted around the arc do the heating and melting. It has been noticed how quickly a large copper wire could be heated indirectly by a current passing through a fine wire wound about it, but electrically insulated from it, and it occurred to me that possibly a good conductor of heat like copper or silver might be made to do the melting by heat imparted to it by a resistance wire wound about it; in this way a pin could be made sufficiently strong to stand the pressure and at the same time be heated by a very small current. Accordingly, a copper pin was wound with fine, insulated resitance wire, about two-thirds of its length, and used with the bare end projecting into the wax (see Fig. 2). This was found to answer the purpose admirably, being more sensitive to current variations than seemed to be reasonable to expect and at the same time being strong and disturbing the wax very little in repeatedly melting through it.

After carrying out this plan in a complete arc lamp it was found that sufficient heat effect could be had from a current of less than one-fifteenth of an ampère to feed the carbons of an ordinary size for a 10-ampère current. This required a total resistance in the shunt of about 700 ohms, 150 in the wire around the pin and 500 in the additional resistance.

It was found also that the movement would adapt itself without readjustment to any current passing the arc. With 10 ampères and a rapid consumption of carbons the feeding was rapid; with smaller currents and a slower consumption of carbons the feed was correspondingly slow. In other words, it kept the proper arc for any current. With a current anywhere from 3 to 10 ampères the arc was kept correspondingly long or short, adapting itself to the current, whatever it was.

I watched this arc for hours at a time without being able to detect the least indication of a feed movement or any change in the length of the opening between the carbons. I struck it with a stick, rattled it about and shook it, but it kept right on as serenely as though nothing had happened, the pin in the wheel of the stearine holding the carbon rod so firmly that it could not be disturbed.

How to be able to adjust or vary the length of arc now required attention. At first it was thought that by varying the depth of the pin in the wax, or by other means varying the amount of wax melted, would answer the purpose, but this was found entirely inadequate; whether the pin had much or little to melt the arc remained practically the same. Noticing how sensitive the arc was to variations in the resistance of the shunt, means were provided by which this resistance could be varied and it was found to be very effective in controlling the length of arc. When it is considered that the heat of the pin is increased four times by doubling the current it will be seen why this means proved so effective.

Some difficulty was encountered in the variations in heat required to start and maintain the arc uniform in all kinds of weather from the extreme cold of winter to the tropical heat of summer, and from the starting with everything cold to the running with everything warmed up. Many ways were attempted to compensate for this difference by automatically varying the resistance of the shunt, but none of these devices answered the purpose effectually until it was found that certain of the metallic conductors varied in their resistance with variations in temperature in almost

exactly the same ratio as the ratio between the heat required to do the melting at a corresponding temperature. This means was adopted and proved itself very simple and effective. The lamp was subjected to a wide range of temperatures without readjustment and showed itself capable of keeping its arc all right. As fast as opportunity offered its capabilities were tested and it was found that it would work as perfectly 40 below the freezing point as at 40 above, and that 96 above zero did not affect its working in the least.

The form of the stearine adopted for this lamp was a ring about three inches in diameter and one-half an inch square in cross section, as seen in Fig. 2. This ring is held between two fangs that are mounted upon the shaft, and the shaft is mounted in boxes so as to allow of its being readily removed and the wax ring renewed without taking down the lamp or causing more inconvenience than the usual renewing of the carbons does. However, it has been found that the wheels do not require renewing as often as it was anticipated, many of them having been in use continuously for months, and some have been in lamps used occasionally for more than two years, without refusing to work.

To adapt this lamp to a series circuit it was found necessary to provide some kind of an automatic cut-out in case of anything interfering with the downward movement of the carbon. This was finally worked out, without using a magnet, in a very simple way. The block holding the heating pin was hung within the frame of the lamp in such a way as to allow of a back and forth movement of about one-fourth of an inch. The weight of the carbon holding rod tending to rotate the wax wheel when against the pin held this movable block to its backward limit while a spring somewhat weaker than the pressure of the rod tended to force the block and pin forward. The forward movement was limited by a contact piece and connections made in such a way as to close a short circuit between the two binding posts when the block was moved forward. Now when the weights of the rod were removed or otherwise hindered from rotating the wheel, the pin continued to melt, and as the spring pressed it forward the circuit was closed through the contact pieces, thus putting out the light and relieving the pin from further heating. This was found to be a practical arrangement and effectually preserved the circuit.

It was thought that the heating pin might possibly be overheated by excessive currents under some circumstances, but it was found that no amount of excessive current could heat the pin or wire surrounding it to much above the melting point of the wax while the wheel was free to rotate against it.

This lamp and others like it have been subjected to severe tests for the past two years in various ways. As a series lamp they have run in all kinds of weather, indoors and out, summer and winter, in trembling and shaking positions, on constant current circuits of almost every kind in use, single from a small machine, and in series with 10 to 50 others, with highly gratifying results. As a parallel lamp on a constant potential circuit with incandescent lamps, they showed themselves remarkably well adapted to the work on account of the steadiness of the resistance they maintained by the steadiness of the arc.

With no other changes in the mechanism than the omission of the cut-outs or short circuiting devices of the series lamp and the substitution of a circuit and contacts arranged to cut out the resistance shunt instead of short circuiting, the lamps worked perfectly, either two in series with one ohm resistance across 110 volts, or four in series across 220 volts with two ohms resistance.

New York State Railway Association.

The tenth annual meeting of the Street Railway Association of New York State will be held at the United States Hotel, Saratoga Springs, on Tuesday, Sept. 20, at 10 o'clock A. M. Two papers will be read: "Recent Improvements in Cable Traction," by George W. McNulty, engineer, Broadway and Seventh Avenue Railway of New York, and "Recent Improvement in Electric Traction," by L. H. McIntire, engineer Harlem Bridge, Morrisania and Fordham Railway, New York. The meeting promises to be an interesting one and a large attendance is expected

Plant of the People's Electric Light and Power Company at Oswego, N. Y.

That Oswego should look to the river which sweeps through its limits for light as well as power is but natural. Few cities have the advantages of an abundant water supply in their very midst, and President Graves, of the People's Electric Light and Power Company, saw at once that the Oswego River should furnish the power for illuminating the city. In the face of considerable opposition a site was secured in the central portion of the city and the plant constructed. A view of the power house, with a glimpse of the river beyond, is given in Fig. 1. The office and storerooms, which are not shown in the illustration, are situated on the street and connected to the station by a bridge which leads over the canal or sluice.

FIG. 1.—CENTRAL STATION AT OSWEGO.

On the first floor of the power station are two Rodney-Hunt water wheels of 300 h. p. each, which are seen in Fig. 2, and also a Marvin-Briggs 450 h. p. Corliss engine, which is only used in case the water supply should for any reason not be available. Boilers, steam fittings, etc., of the John E. Beggs manufacture, and a Davis feed water heater, complete the apparatus on this floor. A small boiler furnishes steam for heating the station and office, which is carried across to the latter in a pipe protected by the box seen to the left of the bridge in Fig. 1.

The turbines are belted to a countershaft in the second floor, the large driving belt being a 30-inch eight-ply Underwood cotton leather double belt. The clutches are of the Hunter type. A portion of the countershaft is seen in Fig. 3 showing the driving belts and belt tightener, several of the dynamo pulleys and belts and the turbine governor. This governor is a Pritchard automatic regulator and has already been described in the columns of THE ELECTRICAL WORLD.

The inventor of this device, Mr. Pritchard, was the first superintendent of this station, and the regulator shown in the cut was the first one constructed. As is well known, it is an electrical device by which two pairs of magnets control by suitable mechanism the water gates, which may be seen to the right in the foreground of Fig. 1. If the load decreases the regulator automatically closes the gates sufficiently to prevent any racing, whereas if a heavy load is suddenly thrown on the gates are opened until there is a sufficient volume of water to furnish the requisite power.

The dynamo room, which occupies the whole of this floor, is 75 feet in length and 45 feet wide. It contains two Thomson-Houston incandescent 650-light machines, five Wood arc machines, each of 60-light capacity and two 80-h. p. Thomson-Houston generators. The company has the city contract for lighting the streets for a period of five years and the capacity of the station is crowded to its full extent. The room under the roof is reached by a staircase from the dynamo room and serves as a testing room and repair shop.

The company owns and operates the only street car line in Oswego. This line has been extended to the fair grounds and to a neighboring summer resort. Five Brill cars equipped with two 15-h. p. motors are generally run both summer and winter, but during the present season it is expected that this number will have to be increased.

The station is most conveniently situated. In case that the water power should fail and it should be necessary to operate the steam plant, coal can be delivered from barges directly and the river furnishes an abundant water supply. Under any circumstances great economy is attainable. The property seen to the left of the present station belongs to the company, and it is already preparing to erect a new building, or, more properly, to extend the old one, so as to double its capacity.

Moonlight Tables for August, 1892.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of August, under his modified form of moon schedule:

TABLE NO. 1. Standard Moonlight, Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	10:35 P. M.	2	4:00 A. M.	1	7:40 P. M.	2	4:00 A.M.
2	11:05	3	4:00	2	7:40	3	4:00
3	11:45	4	4:00	4	7:40	5	4:00
4		4		5	7:40	6	4:00
5	12:35 A. M	5	4:05	6	7:40	6	12:00 M.
6	1:35	6	4:05	7	7:35	7	12:00
7	No light.	7	No light.	8	7:35	8	12:00
8	No light.	8	No light.	9	7:35	9	12:00
9	No light.	9	No light.	10	7:35	0	12:00
10	7:35 P. M.	10	9:40 P. M.	11	7:30	11	12:00
11	7:30	11	10:05	12	7:30	12	12:00
12	7:30	12	10:30	13	7:30	13	12:00
13	7:30	13	11:00	14	7:30	14	12:00
14	7:30	14	11:30	15	7:30	15	12:00
15	7:25	16	12:05 A. M.	16	7:25	17	12:00 A.M.
16	7:35	17	12:50	17	7:20	18	1:15
17	7:20	18	1:45	18	7:20	19	2:45
18	7:20	19	2:45	19	7:20	10	4:15
19	7:20	20	4:15	20	7:20	21	4:20
20	7:20	21	4:20	21	7:20	22	4:20
21	7:20	22	4:20	22	7 15	23	4:20
22	7:20	23	4:20	23	7:15	24	4:20
23	7:15	24	4:20	24	7:15	25	4:20
24	7:10	25	4:20	25	7:10	26	4:20
25	7:10	26	4:20	26	7:10	27	4:20
26	7:10	27	4:20	27	7:10	28	4:25
27	8:10	28	4:25	28	7:10	29	4:25
28	8.35	29	4:25	29	7:10	20	4:25
29	9:00	30	4:25	30	7:10	31	4:25
30	9:40	31	4:25	31	7:10	31	4:25
31	10:20	1	4:30				
Total hours lighting, 168.45.				Total hours lighting.			

The Length of Submarine Cables.

The following are the lengths of the submarine cables now laid and in operation, taken from the documents published by the International Bureau of Telegraphy, of Berne, Switzerland.

The various governments of the world own together 880 cables having a total length of 14,480 miles, and containing 21,560 miles of conductors. The French government, which takes the lead as to length of cables, has 3,460 miles in 54 cables. As to number, the Norwegian government comes first with 255 cables, having a total length of 248 miles. Finally, as to the length of conductors, the English government comes first with 5,468 miles of conductors, divided among 115 cables, having a total length of 1,588 miles.

Private companies to the number of 28 own 288 cables, having a length of 126,864 miles and containing 127,632 miles of conductors. The French companies, only two in number, the Compagnie Française du Telegraphe de Paris à New York and the Société Française des Telegraphes Sous-Marins, have 18 cables with a total length of 7,249 nautical miles. The most important of the private companies is the Eastern Telegraph Company, which operates 75 cables with a total length of 25,374 miles. The total number of the cables in the world is 1,168, with a total length of 140,344 miles and 149,193 miles of conductors. This is not sufficient to reach to the moon but would extend more than half way there.

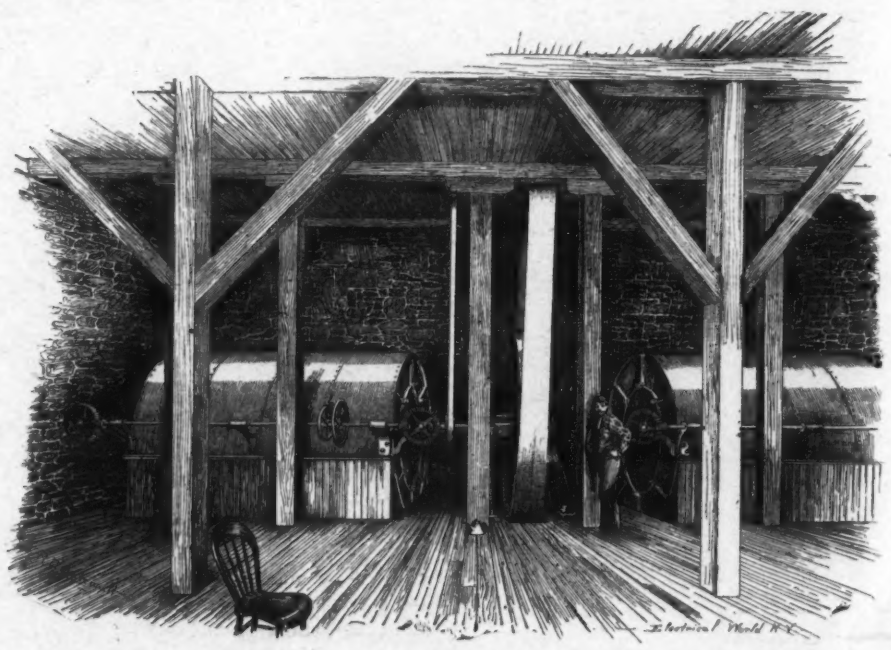


FIG 2.—TURBINES IN THE OSWEGO PLANT.

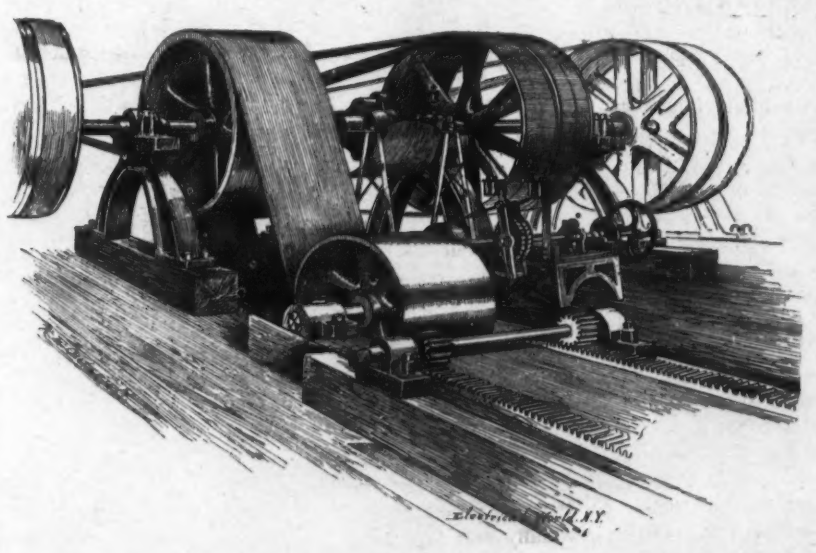


FIG. 3.—SHAFTING AND BELTING IN THE OSWEGO PLANT.

The Storage Battery and Car of the Ford-Washburn Storelectro Company.

SINCE the fight against the overhead trolley wire in our large cities has stimulated the development of the storage battery and the conduit systems great progress has recently made in both these directions. Of these two the storage battery system has repeatedly been called the "ideal" system by impartial and expert engineers; but such remarks have always been followed by the modifying clause that at that time there was no satisfactory battery. Progress in storage batteries is therefore watched with interest and the lucky inventor who succeeds will reap a rich harvest.

Among the recent improvements in storage batteries, which are ingenious and novel, and which overcome the most important objections to the old form of batteries, are those made in the battery devised by Mr. G. A. Ford and George Washburn, of the Storelectro company, of Cleveland Ohio. Before describing their cells it may be well to call attention to the chief faults of the well-known grid battery, as it was originally made, and as it is still made with but little change.

Owing to the expansion and contraction of the material in the grids, the plates buckle, because lead is not elastic; but even if they should not buckle, the material loosens, which leads to bad contact between the active matter and the grid, which, in turn, leads to sulphating at the loose contact. Both these causes tend to make the active matter drop out, lessening the capacity of the plate and often short-circuiting the battery.

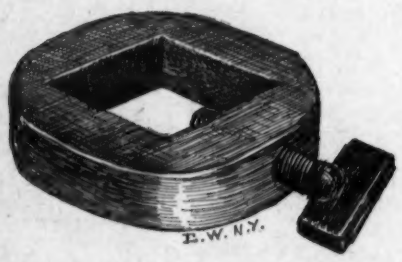


FIG. 1.—BATTERY CONNECTOR.

The improvements of the Storelectro company's cell will now be better appreciated. The inventors have abolished the grids entirely, and even the plates, strictly city of the peaking. Referring to Fig. 2, it will be seen that one cell s made up of five similar units or parts. Each of these corresponds to a pair of plates in the usual grid form. A very thin porous cup, only ⅛ inch thick, is covered on the outside with a thick layer of active material, around which is placed a sheet of perforated lead, as seen in the figures; the perforations are for the circulation of the acid

A similar but smaller sheet is placed in the inside of the cup, the space between it and the cup being also filled with active matter; it is to be noticed that there is an open space in the interior to allow for expansion and contraction inside the cup, as also to leave a sort of reservoir of acid. The lead sheets act merely as conductors for the active matter on the two sides of the porous cup. The outside forms the negative plate and the inside the positive. All the negative lead sheets are connected together at the bottom by a strip which comes to the top, forming the negative terminal of that cell, while all the positives are similarly connected at the top, forming the positive pole. This makes a much better distribution of the current density over the two plates than if both were connected at the top as usual.

It will be seen that owing to the porous cup which separates the plates there is absolutely no possibility of short circuiting between the plates, unless the cup should break. Furthermore, from the nature of the arrangement, buckling does not take place, or even if it should it could do no harm. The free space in the cup is to take up the expansion which otherwise causes buckling. Thus it will be seen that both of the intrinsic faults of the usual grid plates cannot exist in this radical departure from the common form. As these faults are overcome the cell needs practically no attention, as nothing can happen to it.

The 150 ampère hour cells, which are the ones used for traction, are 12 inches high by 4½ by 8 inches; the weight complete is given as 40 pounds.

One car contains 180 of these cells, placed under the seats as shown in Fig. 3, the total weight being 7,200 pounds. The reason the usual grid batteries cannot stand a heavy rate of discharge is that it causes buckling and fall ing out of the material. As that cannot take place in this new cell, this reason does not exist and they may therefore be discharged at any desired rate without injury, which, for traction work, is of course a most important feature.

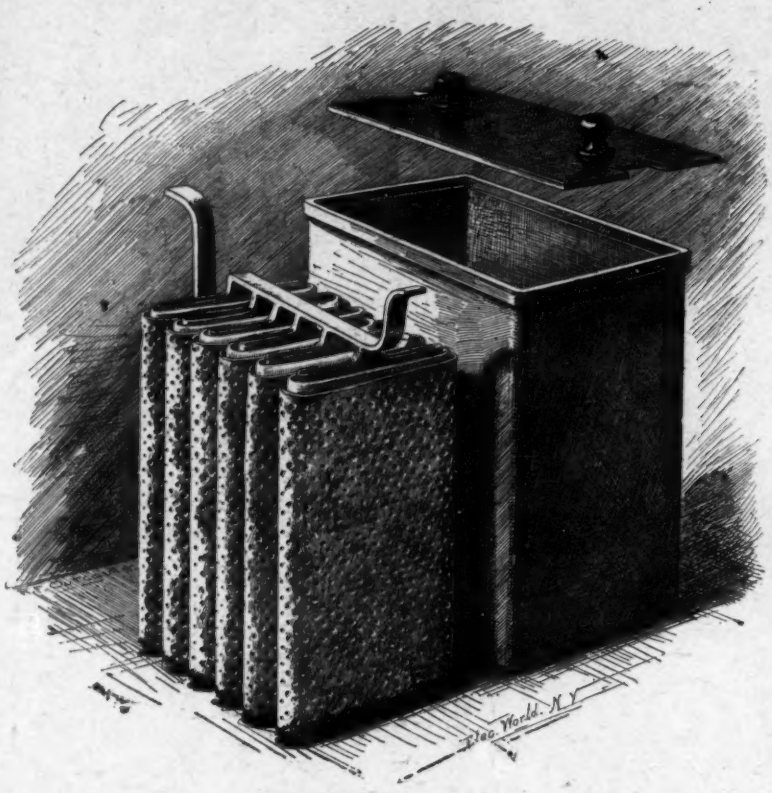


FIG. 2. FORD-WASHBURN STORAGE CELL.

Fig. 1 shows a detail, namely, the coupling clamp, which might seem like an unimportant matter, but which in other forms has given rise to a great deal of trouble.

The motor and truck are seen in Fig. 4, and will explain themselves. The 35-h. p. Ford-Washburn motor used weighs 2,000 pounds and is series wound. The field is wound in sections, which may be grouped by means of a switch, so as to obtain different speeds by the well-known methods. The cells also may be grouped differently by means of a switch, so as to obtain greater current at less voltages. Both of these methods may be used together.

The car has been running on the Woodland Avenue and West Side and Cleveland street lines in Cleveland, O., for some time, and its success appears to be assured.

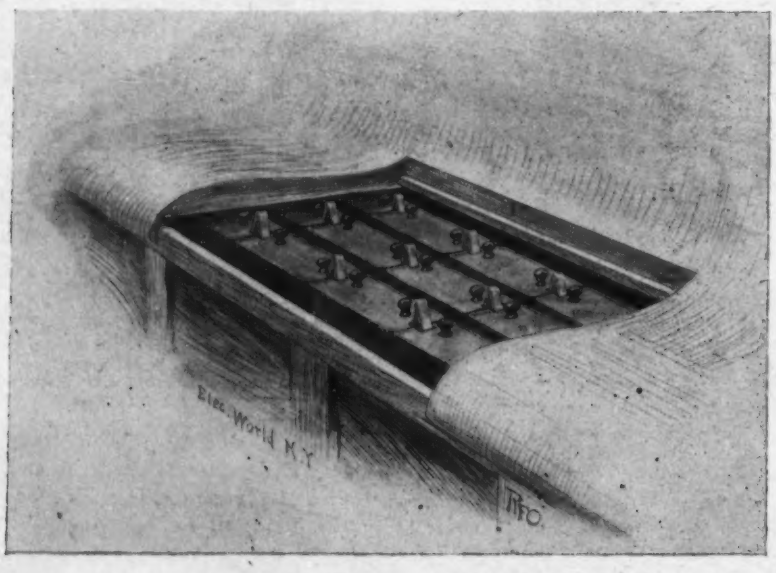


FIG. 3.—ARRANGEMENT OF CELLS IN A CAR.

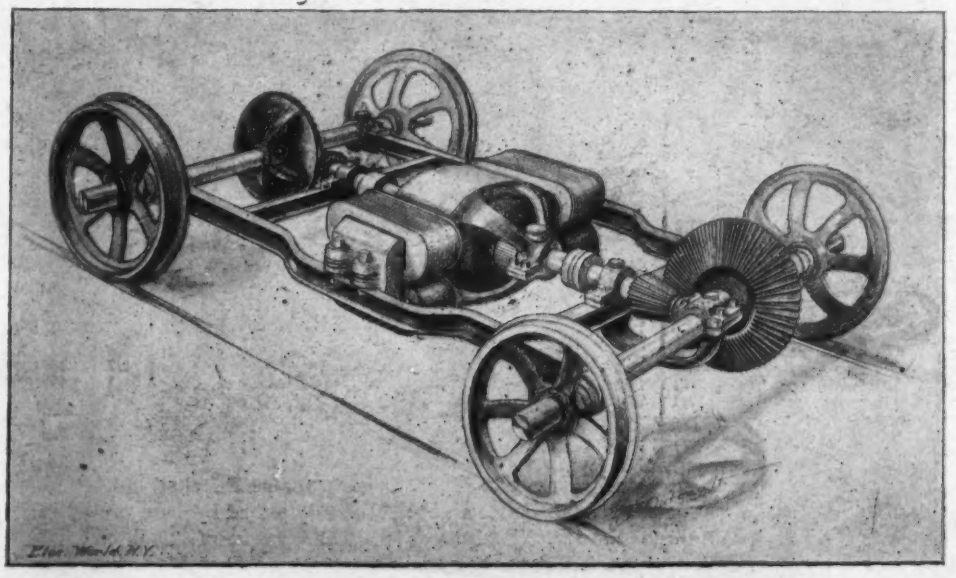


FIG. 4.—FORD-WASHBURN CAR MOTOR AND TRUCK.

The Kolon Primary Battery.

Notwithstanding the multitude of primary batteries that have appeared, none seems to have combined the essential qualities of a practically constant electromotive force of two volts, large discharge capacity and absence of heavy local action on open circuit—the good points of a storage cell. That these claims are now covered better than they have been heretofore would seem to be the direct inference from the results of a test of the Kolon primary battery which we witnessed last week. A single cell repeatedly gave upward of 100 ampères discharge, on short circuit at .5 volt E. M. F., through a Weston ammeter, the complete recovery to two volts occurring immediately on breaking the circuit, while at low rates of discharge the E. M. F. was constantly over 2 volts. The internal resistance of the cell by a rough test was found to be as low as .025 of an ohm.

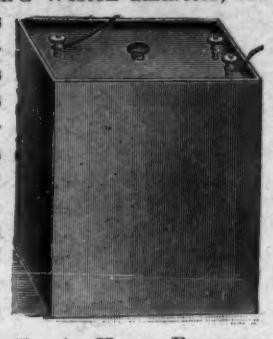
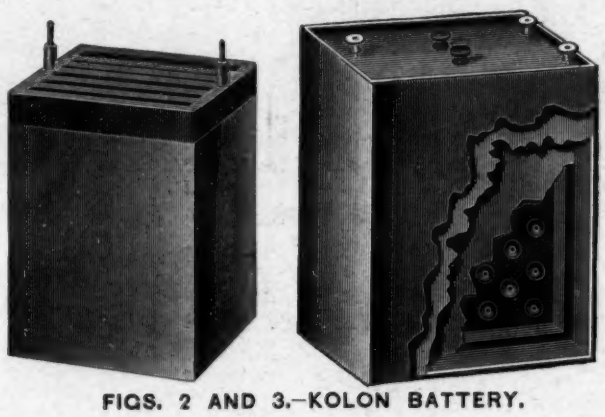


FIG. 1.—KOLON BATTERY.

The absence of local action is explained by the thick walls of the carbon cup shown in Fig. 2, yet it is a curious circumstance that, while these walls by reason of their size offer a high mechanical resistance, they offer a low electrical internal resistance in the battery. These results, it is claimed, are obtained by employing carbon differing in material from any heretofore used, and by having the large carbon surface of over 850 square inches placed by the cell's construction as near as one-half inch from the zinc. This main feature, which is claimed to solve the chief difficulties so often encountered in primary cells, is shown in Fig. 2, consisting of a carbon cup with five carbon plates, the walls of which are five-eighths of an inch thick and stand 8¼ inches in height by 6¼ inches square.

Around the upper edge of this cup extends a copper band, well protected from the corrosive action of acids. The carbon cup, which does service as both a porous diaphragm and one electrode, is filled with a chromic solution and is then placed in the hard rubber case shown in Figs. 1 and 3, the outside dimensions of which are 7¼ inches square by 9 inches high. Closely fitting in this rubber shell is a thin zinc plate bent in rectangular form, wholly immersed in the dilute sulphuric acid, which fills the space between zinc and carbon, and connected to its binding post by an amalgamated copper strip. The zinc, though rolled, is thoroughly permeated by mercury, and in consequence does not require amalgamation. The cell is closed, to prevent evaporation, by a hard rubber cover. In appearance and action the resemblance to a storage cell is noticeable, though many failings of the latter under heavy discharges are lacking. Freedom from corrosion, fumes, creeping salts and the simplicity of but two working parts, combined with the cheap maintenance claimed for it, are all in favor of the Kolon which should find popular favor by reason of its applicability to all light work such as fan motors, small lights, cautery and dental applications, phonographs and the many legitimate uses of primary batteries. A high rating of 300 ampère hours is given this size cell under low discharges.



FIGS. 2 AND 3.—KOLON BATTERY.

We are indebted to Converse D. Marsh, of 136 Liberty street, this city, for the opportunity of thorough investigation of the Kolon battery, which he represents.

Test of the Neversink Mountain Electric Road.—X.*

BY HERMANN S. HERING AND WILLIAM S. ALDRICH,
OF JOHNS HOPKINS UNIVERSITY.

VI.—THE TEST OF THE POWER PLANT.—(*Concluded*).

Traction Data from the Three Special Car Tests.—The importance of the performance of electric cars on grades has led the authors to arrange the results of their own special car test, as well as those of the other two tests previously mentioned, in such tabular form as to give all the needed data and results concerning time, grades, speeds, mechanical ing to the quantity dealt with. The time interval, grade lengths and lifts are added values; the mean value for the per cent. grade is the quotient of the total lift divided by the total length and represents the lift per 100 feet (horizontal),—it is in reality the mean up-grade for the car route; the mean speeds are from the total grade lengths and total time. The lift and traction horse powers have for their mean values the quantities obtained from the individual values with the proportional time interval taken into consideration, and are also equivalent to the quantities obtained from the mean lift and car speed. The mean the columns giving that percentage which the lift and traction horse power is of the total car axle horse power, when a traction coefficient of 10 lbs. per 1,000 is used. Taking the 3.64 per cent. grade in Table XVIII., in order to show the effect of using a slightly different value for the traction coefficient, it is found that 8 lbs. per 1,000 gives an efficiency of 70.8 per cent. from the motor terminals to the car axle; while 12 lbs. per 1,000 gives 77.3 per cent. for the corresponding efficiency.

The difference in speed of the car on entering and leaving any up-grade plays a very important part on the ex-

TABLE XVIII.—TRACTION DATA FROM TESTS OF CAR NO. 4.

Made by Messrs. Hering & Aldrich for THE ELECTRICAL WORLD, Aug. 17, 18, 1891. Route, Klapperthal car house and return; weight of car and load, 22,500 pounds; mean speeds from watch-time records.

No. of test.	Time interval.		Grade.				Mean speeds.			Calculated Mechanical H. P. at car axle.					Electrical H. P. at motor terminals and station.						Efficiency.			Remarks.
	m.	s.	Per cent.	Length in feet.	Length in miles.	Lift in feet.	Lift in feet per minute.	Car speed in feet per minute.	Car speed in miles per hour.	Lift H. P.	Traction H. P.	Total axle H. P.	Lift, per cent. of total H. P.	Traction, per cent. of tota H. P.	Mean car ampères.	Mean car volts.	Mean car E. H. P.	Mean station, E.H.P.	E. H. P. for car lift only.	E. H. P. for car traction only.	Dynamo terminals to motor terminals.	Motor terminals to car axle.	Dynamo terminals to car axle.	
1	0	20	3.00	373	0.071	11.2	33.6	1,120	12.70	22.90	7.63	30.53	75.0	25.0	*78.5	*432	*45.5	48.9	34.1	11.4	93.0	67.2	62.3	Starting; low voltage; straight track.
2	1	25	3.50	1,650	0.313	57.7	40.7	1,165	13.30	27.70	7.95	35.65	77.7	22.3	71.0	485	45.9	48.6	35.7	10.2	94.5	77.8	73.5	Straight track only; one curve; voltage high.
3	7	45	3.64	7,805	1.475	284.1	36.7	1,006	11.43	25.05	6.87	31.92	78.5	21.5	67.1	487	43.1	45.9	33.8	9.3	94.0	74.2	69.7	Many curves.
4	2	25	2.50	2,000	0.379	50.0	20.7	828	9.40	14.30	5.70	20.00	71.5	28.5	47.8	444	29.1	32.5	20.8	8.3	89.5	68.8	61.5	Straight track; city limits; stopped.
5	0	30	1.00	400	0.0758	4.0	8.0	800	9.10	5.46	5.46	10.91	50.0	50.0	28.0	469	17.6	18.8	8.8	8.8	93.8	62.0	58.2	Straight track; city limits; lower switch position.
6	0	45	2.40	500	0.0948	12.0	16.0	667	7.58	10.90	4.55	15.45	70.5	29 5	37.4	467	23.4	24.8	16.5	6.9	94.3	66.1	62.4	Straight track; city limits; lower switch position.
7	2	50	5.00	2,025	0.384	101.3	35.7	715	8.10	24.40	4.87	29.27	83.4	16.6	63.4	466	39.7	43.2	33.1	6.6	92.0	73.8	67.8	Two sharp curves.
8	1	10	6.40	925	0.175	59.2	50.7	793	9.00	34.60	5.40	40.00	86.5	13.5	85.0	475	54.1	57.6	46.8	7.3	94.0	74.1	69.5	Steady; straight track.
9	10	0	3.94	9,350	1.77	368.4	36.8	935	10.62	25.40	6.38	31.78	79.8	20 2	66.9	485	42.3	44.7	33.8	8.5	94 8	75.1	71.2	Mostly easy curves and straight track.
10	1	40	4.00	1,475	0.28	59.0	35.4	888	10.10	24.10	6.06	30.16	80.0	20.0	63.1	490	41.7	43.2	33.3	8.4	96.5	72.3	70.0	12° and 16° curves.
11	1	0	1.35	525	0.1004	7.1	7.1	525	5.97	4.84	3.59	8.44	57.4	42.6	25.0	456	15.3	16.1	8.8	6.5	95.1	55.1	52.4	Slow around Highland House curve.
	29	50	†3.75	27,028	5.118	1,014	34.0	906	10.3	23.20	6.20	29.40	79.0	21.0	63.2	479	40.3	42.7	31.8	8.5	94.4	72.9	68.9	Means and totals.

*These being integrated values, the E. H. P. is not necessarily equivalent to the product of the mean volts and mean ampères divided by 746.
†Mean car lift (equivalent to a mean grade) per 100 ft. of total (horizontal) length of the up grades for this round trip. This value is not the same as that given in Table VII., p. 396, THE ELECTRICAL WORLD, June 11, 1892, because in this test the car did not run all the way to the Klapperthal terminal, but to the Klapperthal car house.

TABLE XIX.—TRACTION DATA FROM TESTS OF CAR NO. 2.**

Made by Mr. Chas. Hewitt, for the Edison General Electric Co., June 24, 1891. Route, Klapperthal car house, and return; weight of car and load, 32,700 lbs.; mean speeds from integration of Boyer record.

No. of test.	Time Interval.	Grade. Per cent.	Length in feet.	Length in miles.	Lift in feet.	Mean Speeds. Lift in feet, per minute.	Car speed in feet, per minute.	Car speed in miles per hour.	Calculated Mechanical H. P. at Car Axle. Lift H. P.	Traction H. P.	Total axle H. P.	Lift, per cent. of total H. P.	Traction, per cent. of total H. P.	Electrical H P. at Motor Terminals and Station. Mean car ampères.	Mean car volts.	Mean car E. H. P.	Mean station E. H. P.	E. H. P. for car lift only.	E. H. P. for car traction only.	Efficiency. Dynamo terminals to motor terminals.	Motor terminals to car axle.	Dynamo terminals to car axle.	Remarks.
1	No readings taken.	3.00	373	0 071	11.2	31.4	875	9.95	21.6	6.0	27.6	78.3	21.7	60.6	456	37.1	No readings taken at station.	29.04	8.06	No readings taken at station.	74.5	No readings taken at station.	Three stops, on grade, between full stop at end of grade.
		3.50	1,650	0.313	57.7																		
		3.64	7,805	1.476	284.1																		
		*3 59	9.828	1.860	353.0																		
2		2.5	2,000	0.379	50.0	20.45	819	9.30	14.1	5.6	19.7	71.6	28.4	57.0	379	29.0		20.75	8.25		68.2		Stopped at R. R. crossing.
3		1.0	400	0.0758	4.0	37.1	810	9.20	25.5	5.6	31.1	82.0	18.0	78.5	403	42.5		34.85	7.65		73.3		Speed very irregular.
		2.4	500	0.0948	12.0																		
		5.0	2,025	0.3840	101.3																		
		6.4	925	0.1750	59.2																		
		*4.58	3,850	0.7296	176.5																		
4		3.94	9,350	1.77	368.4	33.6	853	9.70	23.1	5 9	29.0	79.6	20.4	68.2	418	38.2		30.4	7.80		76.0		Speed very steady.
5		4.00	1,475	0.280	59.0	33.8	845	9.60	23.3	5.8	29 1	80.1	19.9	62.2	418	34.9		27.96	6.94		†83.5		††
6	m.	s.	1.35	525	0.1004	7.1	13.7	1,014	11.50	9.45	7.0	16.45	57.5	42.5	63.0	440	37.1		21.33	15.77		44.5		‡‡
	31	0‡	3.75	27,028	5.118	1.014.0	32.8	872	9 90	22.6	6 0	28.6	79.1	20.9	65 5	430	37.75		29.85	7.90		75.7		Means and totals.

* These values are totals and means for these grades. † This high efficiency is probably due to car reaching this grade at a high speed from the preceding down grade (see Fig. 23), and then going up one third the grade without current; or else the given E. H. P. is not the true mean. ‡ Calculated mean time interval. ** These results were arranged and partly computed by the authors. †† Car entered this grade at 13 miles per hour, and slowed up to 8 miles per hour before current was used. ‡‡ Car entered this grade at 15 miles per hour, and irregularly slowed up to full stop at end of grade.

TABLE XX.—TRACTION DATA FROM TESTS OF CAR NO. 3.

Made by the Electrical Engineering Students of the Johns Hopkins University, April 30, 1892.** Route—Klapperthal terminal and return; weight of car and load 24,500 lbs.; mean speeds from watch-time records.

Number of Test.	Time Interval.		Grade. Per Cent.	Length in Feet.	Length in Miles.	Lift in Feet.	Mean Speeds. Lift in Feet Per Minute.	Car Speed in Feet Per Minute.	Car Speed in Miles Per Hour.	Calculated Mech. H. P. at Car Axle. Lift H. P.	Traction H. P.	Total Axle H. P.	Lift, per cent. of Total H. P.	Traction per cent. of Total H. P.	Electrical H. P. at Motor Terminals and Station. *Mean Car Ampères.	*Mean Car Volts.	*Mean Car Electrical H. P.	Mean Station Electrical H. P.	Electrical H. P. for Car Lift only.	Electrical H. P. for Car Traction only.	Efficiency. Dynamo Terminals to Motor Terminals.	Motor Terminals to Car Axle.	Dynamo Terminals to Car Axle.	Remarks.
	M.	S.																					
1	1	0	3.00	675	0.127	20.2	20.2	675	7.67	15.0	5.0	20.0	75.0	25.0	59.6	464	34.2	39.2	25.6	8.60	87.3	58.5	51.1	Run on 2d point of switch; started and stopped.†
2	1	50	3.50	1,650	0.313	57.7	31.5	900	10.22	23.4	6.7	30.1	77.8	22.2	78.5	467	49.3	56.1	38.35	10.95	88.0	61.1	53.7	Run principally on 3d, 4th and 5th switch positions.
3	8	0	3.64	7,805	1.475	284.1	35.5	975	11.08	26.3	7.2	33.5	78.5	21.5	78.5	461	48.6	54.3	38.1	10.50	89.3	69.0	61.7	During ⅛ of time run on lower switch positions.
4	2	30	2.50	2,000	0.379	50.0	20.0	800	9.09	14.8	5.9	20.7	71.5	28.5	57.8	458	32.6	39.3	23.3	9.30	83.0	63.6	52.7	Car made two stops.‡
5	0	28	1.00	400	0.0758	4.0	8.57	857	9.72	6.36	6.36	13.72	50.0	50.0	64.2	426	36.1	39.4	18.05	18.05	91.7	38.1	34.9	Run on 1st, 2d and 4th points on switch; slowed up once.
6	0	36	2.40	500	0.0948	12.0	20.0	834	9.48	14.8	6.2	21.0	70.5	29.5	76.1	461	44.4	50.7	31.25	13.05	87.7	47.3	41.5	Run mostly below the 5th switch position.
7	2	32	5.00	2,025	0.384	101.3	40.0	800	9.09	29 7	5.9	35 6	83.4	16.6	86.4	447	50.7	59.7	42.3	8.40	85.0	70.3	59.7	Run on 7th point of switch.
8	1	13	6.40	925	0.175	59.2	48.6	760	8.63	36.0	5.6	41.6	86.5	13 5	94.2	468	58.7	66.0	50.8	7.90	89.0	71.0	63.1	Run on 7th point of switch.
9	10	20	3.94	9,350	1.770	368.4	35.6	905	10.28	26.4	6.7	33.1	79.8	20.2	73.8	477	45.2	50.6	36.06	9.14	89 7	73.1	65.5	Run mostly on 7th point of switch.
10	1	31	4.00	1,475	0.280	59.0	37.6	942	10.70	27.9	7.0	34.9	79.97	20.03	74.7	486	46.1	51.6	36.85	9.25	89.4	75.8	67.7	Run on 7th point of switch.
11	0	30	1.35	525	0.1004	7.1	14.2	1,050	11.90	10.6	7.8	18.4	57.6	42.4	61.1	455	33.2	35.2	19.12	14.08	94.5	55.5	52.3	On 25 deg. curve, ⅓ of time on 4th point.†
12	0	45	3.60	475	0.090	17.1	22.8	633	7.20	16.9	4.7	21.6	78.25	21.75	71.0	420	33.8	41.9	26.42	7.38	80.7	64.0	51.5	Slowed up and stopped at Klapperthal terminal.
	31	18	3.74	27,805	5.264	1040.1	33.3	888	10.10	24 7	6.6	31.3	79.0	21.0	75.0	476	45.5	51.3	35.9	9.60	88 7	68.8	61.0	Means and totals.

*Integrated means. **See THE ELECTRICAL WORLD, p. 351, May 31, 1892. † Traction coefficient too low. ‡ Length of stop not included.

horse power at the car axle, electrical horse power at the motor terminals and station, and the efficiencies of the line and motors for each up-grade of the round trip. The proportional part of the electrical horse power delivered to the car and expended in lifting the car at the given speed on each particular grade has been tabulated side by side with that expended in tractive effort alone on the corresponding distance.

The calculated mechanical horse power at the car axle has been determined in the same manner as explained in the preceding issue. At the bottom of each table in the horizontal line of "Means and Totals," the average values are given which have been determined in each case accordampères, volts and electrical horse powers were similarly obtained by giving weight to the proportional time interval. The mean efficiencies are of course obtained from the mean values.

The efficiencies involving an assumed traction coefficient are only of interest as showing the comparative results on the different grades of similar cars, when a uniform value is taken for this coefficient. As is well known, this varies for the most part with the curvature of the road, which could not have been allowed for, owing to the lack of reliable data at hand. Therefore, too great an importance must not be given to any of the values in the tables involving traction horse power; for instance, a slight change in the traction coefficient has more or less effect upon the resulting efficiency according to the grade; this is shown in penditure of energy on the same. Thus, when a car enters at a higher speed than when it leaves, some of the energy stored up in the preceding grade (whether up or down) has been drawn upon in lowering the momentum of the car; the electrical energy expended upon this particular grade is, therefore, less than that which would have been required had the car not drawn upon its momentum, but otherwise left the grade at the same speed with which it entered. On the other hand, a car entering an up-grade at a lower speed than that with which it leaves, brings about the opposite conditions, requiring a larger expenditure of electrical energy than the grade naturally demands at a uniform speed. If, therefore, the car enters and leaves at the same speed, or if it starts from a full stop at the foot of the grade and is brought to a full stop at the

*For the first nine sections of this article see THE ELECTRICAL WORLD of May 28, June 4, 11, 18, 25, July 2, 9, 16 and 23, 1892.

top, without the use of brakes, the mean electrical horse power for the entire grade represents the true expenditure of energy in going up the same. This cause produces but little effect on the mean results for long grades such as the 3.64 per cent. and 3.94 per cent.; and, as but few stops were made during this test, the speeds on entering and leaving grades have been assumed constant in making the calculations, and this will account for some of the variations in the efficiencies.

The values for efficiencies given in Tables XVIII. and XX are quite different for many reasons; in the former case, car No. 4 was operated chiefly on the seventh switch position, while in the latter with car No. 3, the lower switch positions were frequently used: the traction coefficient was probably low for car No. 3, as the road and the car had been but little used so far this season, and therefore not in the best condition, the rails being more or less rusty. This also accounts partly for the smaller line efficiency in Table XX., especially as this test of car No. 4 was made at night, when the rails and trolley were slightly covered with moisture. The test of car No. 4 as well as that of No. 2 was also made in the midst of regular passenger traffic in the summer season, and after everything had been in successful operation for some time. Though the cars were similarly equipped, there may have been a difference in their actual efficiencies under the same conditions; however, it is more probable that all these various causes have entered to vary these efficiencies.

TABLE XXI.—SUMMARY OF POWER DISTRIBUTION AND EFFICIENCIES, WITH SPECIAL TEST CAR NO. 4, ON THE TWO PRINCIPAL GRADES, 3.61% AND 3.91%, NO OTHER CAR BEING ON THE ROAD AT THAT TIME.

Grade on which reading is taken.	* 3.64%.		** 3.94%.	
Time and time interval on grade.	11-37-30	11-31-45 to 11-39-30	12-8-0.	12-6-0 to 12-16-0.
Conditions.	Steady.	Mean.	Steady.	Mean.
Speed of turbine shaft	97.0	98.5	97.0	101.5
Gate opening, No. 1 turbine	31.7	30.6	31.0	30.2
" No. 2 turbine (fixed gate)	17.4	17.4	17.4	17.4
Speed of car,† miles per hour	12.4	11.43	11.4	10.62
Power delivered.				
Hydraulic H. P. delivered to turbines	190.0	187.0	188.2	184.2
Turbine H. P. delivered to transmission machinery	93.2	88.7	91.4	86.0
H. P delivered to dynamo	56.1	53.15	55.1	51 9
E. H. P delivered to line	48.5	45 9	47.6	44.7
E. H. P. delivered to car motors ‡	46 0	43.1	44.8	42.3
H. P. delivered at car axles	34.50	31.92	33.7	31.78
Power lost.				
Turbine friction H. P	96.8	98.3	96.8	98.2
Trans. mach'y friction H. P	37.1	35.55	36.3	34.1
Dynamo losses	7.6	7.25	7.5	7.2
Line losses	2.5	2.8	2.8	2.4
Car motor, gearing and axle losses.	11.5	11.18	11.1	10.52
Total losses, hyd. H. P. to car axle H. P	155.5	155.08	154.5	152 42
H. P. available at car axle	34 5	31.92	33.7	31.78
Total hyd. H P. delivered	190.0	187.0	188.2	184.2
Proportional parts of full load.				
Hyd. load, per cent. of full hyd. H P.	36.2	35.7	35.9	35.2
Turbine load, per cent. of full turbine H. P	22.5	21.4	22.1	20.6
Dynamo load, per cent. of full dynamo output	36.2	34.2	35.5	33.3
Motor load, per cent. of full motor output	73.5	68.8	71.5	67.7
Percentage distribution.				
Turbine friction, per cent. loss	.509	.526	.514	.533
Trans. mach'y friction	.195	.187	.194	.185
Dynamo	.040	.038	.040	.039
Line	013	.015	.014	.013
Car motor, gearing and axle losses.	.061	.063	.059	.057
Available power at car axle	.182	.171	.179	.173
Total hydraulic power	1.000	1.000	1.000	1.000
Summary of efficiencies.				
Efficiency of No. 1 turbine	58.7	57.4	58.0	55.8
" No 2 turbine	33.8	32.9	34.0	31.4
" coupled turbines	49.1	47 4	48.5	46.7
" trans. mach'y	60.2	59.9	60.3	60.4
" No. 1 dynamo ¶	86.5	86.3	86.4	86.1
" line, mean, for given grade	94.8	94.0	94.1	94.8
Efficiency of car motors, from terminals to car axle	75.0	74.2	75.2	75.1
Efficiency from dynamo terminals to car axle	71.2	69.7	70.8	71.2
Efficiency from hyd. H. P. to line H. P	25.5	24.5	25.3	24 2
Efficiency from hyd. H. P. to car axle H. P	18.2	17.1	17.9	17 2

* On 3.61% grade car started under normal and almost steady conditions at No. 13 turnout, and slowed up at No. 12 turnout; record ends, without stopping car, at Upper Junction.

** On 3.94% grade car started from a full stop at White House, stopped twice *en route*, and almost stopped at end of grade at No. 7 turnout.

† Mean speeds on grade are exclusive of stops.

‡ Car equipped with two No. 12 Edison S.-R. 25 H.-P. motors, style B.

¶ 100 K. W. Edison railway generator, rated at 650 revolutions per minute.

Weight of car alone 22,000 pounds; weight of car and load during test, 22,500 pounds.

Diagram of Comparative Performance of Cars on Grades.—Most of the values given in Tables XVIII. XIX. and XX. have been plotted over the corresponding grades of the car-route profile, in Fig. 25. Such graphical representation shows very clearly the distribution of the average power on grade, from station to car axle, as well as the speeds, volts and ampères on the same for the entire car route.

In Fig. 25 the car route profile is the same as that of Fig. 22 of a former article; the grade lines drawn through the point where changes of grade occur have been carried upward as ordinates between which the plotted values have been drawn. The mean car speeds and volts are plotted for all the grades. The letters (*a*), (*b*), (*c*), (*d*) and (*e*) have been used to designate the different lines of the plot which refer respectively to the horse powers at the left of the diagram. These values, being means, are drawn in straight lines; therefore the vertical distance between the two lines (*d*) and (*e*) represents the mean horse power lost in the line transmission for the total length of any particular grade; from (*c*) to (*d*) represents the loss in the motors and gearing. The line (*e*), representing the axle horse power, has its ordinate on any grade equal to the sum of the ordinates of the traction horse power line (*a*) and lift horse power line (*b*).

Summary of Power Distribution and Efficiencies on Two Principal Grades.—The performance during the special test of the car No. 4, on the longest grades of the line, with no other car on the road at that time, presents several interesting features obtainable from the data given in Tables XVII. and XVIII. The conditions of the test on these grades were referred to in connection with Table XVII.; also in that table the integrated means were given as obtained from the plot of the special car performance (Fig. 24) and the values under steady conditions as read from the curves of that plot. The arrangement in tabulating this summary follows that of Tables X. and XI.—the summary of the power distributions and efficiencies from the test of the power plant. In each case these tables of summaries show the successive distribution of the power delivered, from the hydraulic horse power at the turbine to the available horse power at the car axle; the respective power losses in the several transmissions; the proportional parts of the full load, under which the prime movers, generators and motors, were working; the percentage distribution of the total hydraulic power of the turbines for the particular condition of these gates, and the several efficiencies of the successive transmissions.

In comparing these two summaries, it is to be remembered that during the test of the power plant there were four or five loaded cars going at various speeds on the different grades, and successively at different points along the road during the entire test; therefore, the summary of the power plant test represents the aggregate performance of the system, under almost continually varying conditions with but very short intervals of no load—conditions which made it impossible for the turbines to settle down to steady running at any time during the test.

The summary of the special car test, on the other hand, represents the performance of the plant and the distribution of the power throughout the system, when only one car of known weight and load was operated at average speeds on known grades between definite points along the road; therefore, the time ordinates selected for the respective grades are those for which the curves of Fig. 24 represent the actual performance under steady conditions, the values for which and the deductions therefrom are given in Table XXI.; and for the entire grade the actual performance of the system is very well represented by the mean values of the same table.

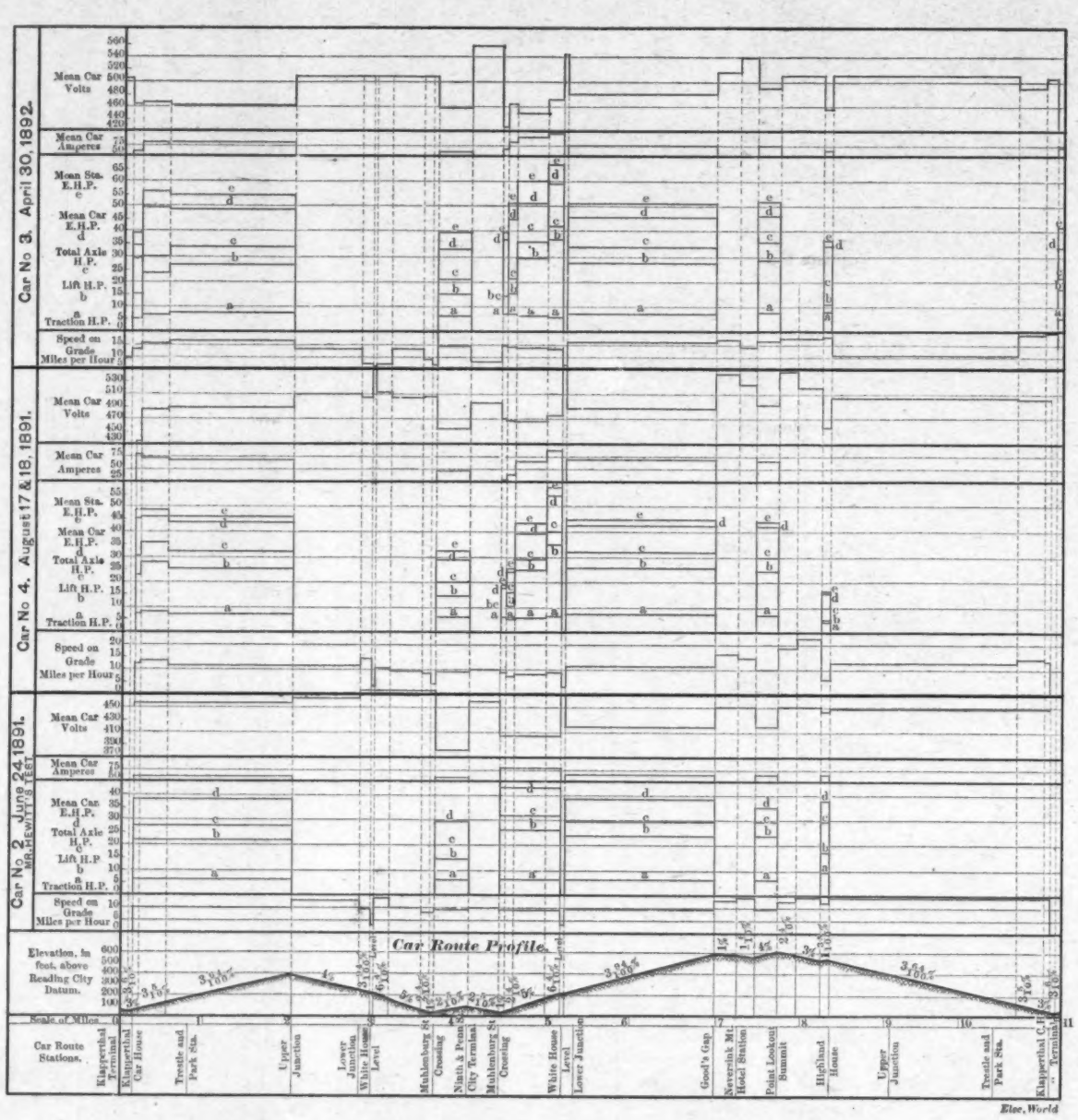


FIG. 25.—COMPARATIVE PERFORMANCE OF NEVERSINK CARS NOS. 2, 3 AND 4.

(Distribution of Average Power on Grades, from Station to Car Axle, for Entire Car Route.)

In closing this report of the test of the Neversink Electric Road, the authors wish to express their many obligations to the following parties, for much valuable assistance and supplementary data.

The Neversink Mountain Railroad Company, through its president, Mr. Richard T. Leaf, and its general superintendent, Mr. Paul D. Millholland, who gave the authors the freedom of the road and every facility for completing the details of the test.

Mr. S. W. Morse, the superintendent of the electrical construction of the road, who rendered much valuable assistance during the test of the power plant and that of the special car No. 4, and gave considerable information concerning the road, as the representative of the Edison company.

Mr. William H. Dechant, manager for the engineering and surveying department of Kendall Bros., for map, plan and profile of the road, the power house drawings and other valuable data.

The Holyoke Machine Company, for complete blue prints of the turbine installation, and results of tests made of their wheels at the testing flume of the Holyoke Water Power Company.

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Mr. William McClellan, of the Reading High School staff, for arranging preparatory details and assisting in the observations.

The editors of THE ELECTRICAL WORLD, to whose untiring efforts and extreme care the very creditable production and arrangement of the several cuts, diagrams, tables and other matter composing these articles, in the columns of this journal, has been entirely due,

Electro-Metallurgy.—VII.*

BY F. M. F. CAZIN.

8. FARADAY'S EQUIVALENTS IN ELECTRO-CHEMICAL DECOMPOSITION IN THE LIGHT OF FACTS AS NOW KNOWN.

Faraday, the great pioneer in modern natural philosophy, by advancing a fallacy relating to the conservation of force, paved the way to the greatest achievement of the century in matters of science, viz., the discovery of the eternal conservation of energy.† In a similar manner he laid the foundation for a correct perception of the quantity of electric action by proclaiming in 1834 the existence of equivalence in electro-chemical decomposition, though he never defined the equivalents precisely, and never gave expression to a natural law under which they might be determined.

And yet to the present day his statements, true, when correctly read, but indefinite and incomplete in the light of present knowledge, have been accepted and revered as almost infallible, and have justly made his name a representative one for scientific progress. And only critical investigation, characteristic of these present days, striking high and low, has brought a better understanding of electrolytic equivalents than Faraday possessed or expressed.

Since Faraday, in 1834, in the *Philosophical Transactions*, treated of equivalents in electro-chemical decomposition, his opinions were referred to by every writer on this subject, but none of them makes verbal quotations, and he is evidently quoted more by transcription than by any words of his own. And this to a certain degree was unavoidable, for want of well formulated theorems that covered the whole ground, and for want of equations that would express the facts, as he claimed and understood them.

Casting his sundry statements into a form that describes well his position in the premises they would read as follows:

"By the same galvanic current equivalent quantities of matter are disengaged within the same time, and these quantities of disengaged matter are not proportionate to their atomic weights, but they are proportionate thereto only by sundry experimental valencies, serving as coefficients to the atomic weights, such valencies varying for different matters and compounds, that may be grouped as classes by these valencies."

A peculiar result of the absence of clearly defined theorems in Faraday's own words is the fact that what is always called "Faraday's Laws" is quoted by every author writing on the subject in different words. I have before me books on electrolysis by McMillan, Watt and Gore, in English; Fontaine, in French; Ad. Wuellner, F. Vogel, A. Roessing, W. Borchers and C. A. M. Ballig, in German, and not one of these authors quotes Faraday verbatim, nor does the quotation of one of them conform with the quotation of any of the others.

One of the authors quoted, Ad. Wuellner, whose quotation comes nearest to the original, states in the preface to his celebrated "Lehrbuch der Experimental Physik," on page 6 of the first of the four volumes as follows:

"Every natural law evolves a series of consequent conclusions that follow from such law; and the means for evolving these conclusions is found in mathematics, resulting in the necessity of expressing natural laws in mathematical equations.

"The degree of progress in any science is evidenced by the applicability to it of mathematical equations."

No scientist of the present day would dispute the correctness of this statement, and the acknowledgment of the fact that it is the tendency of present progressive scientific endeavor to formulate natural laws into algebraical equations and to use these equations as a test of truth and fullness of statement.

The present series for the first time has formulated mathematical equations for electrolytical laws. If not at once, they should find general recognition, as it is but in harmony with conservative resistance to scientific progress. They cannot fail to call for either recognition or correction on the basis of scientific and critical research.

In the following lines these equations are clearly set forth and at the same time employed for evolving a yet further conclusion, namely:

$$\text{If } Q = \frac{A\,W\,P \times c\,P}{2 \times c\,N} \times 0.00001 \text{ gm.}$$

expresses the quantity of positive matter disengaged per ampère-second, 10,000 coulombs disengaging an

$$\left.\begin{matrix}\text{Electro-chemical equivalent of positive matter}\end{matrix}\right\} = \frac{A\,W\,P \times c\,P}{2 \times c\,N} \text{ gms,}$$

$$\text{and if } Q_{(1)} = \frac{A\,W\,N}{2} \times 0.00001 \text{ gm.}$$

expresses the quantity of negative matter disengaged per ampère second, 10,000 coulombs disengaging one

$$\left.\begin{matrix}\text{Electro-chemical equivalent of negative matter}\end{matrix}\right\} = \frac{A\,W\,N}{2} \text{ gms.,}$$

that then

$$R_{(2)} = 2.\,\frac{c\,N}{c\,P} \text{ volts,}$$

expresses the electrical pressure depending on to the reaction, as long as the energy required is not modified by a modification of volume between compound and components.

*For the sixth section of this article see THE ELECTRICAL WORLD of July 23, 1892.

† This law of nature was first clearly expressed and supported by known facts and arguments in 1842 by the physician T. R. Meyer, of Heilbronn, Germany.

The latter equation is based on the conclusion from facts already previously shown, viz.: As the energy required for and conditional to the disengagement of compound matter is proportionate to the heat produced, when the compound was formed, and as the heat so produced (but further dependent on modification of volume) is proportionate in chemical reaction to the negative matter absorbed in the compound, therefore, the electric energy required for disuniting compound matter must be proportionate inversely to the quantity of negative matter in the compound.

And this relation between positive and negative matter is expressed by

$$R_{(2)} = \frac{c\,N}{2\,c\,P} \text{ volts,}$$

as will be further shown below, and it will also be shown why this coefficient, expressing the proportion between $\frac{A\,W\,N}{2}$ and $A\,W\,P$ in the compound, also expresses the electric pressure required for and conditional to disunion of matters in the precise electric value of "volts." By

$$A\,W\,P \times c\,P \div A\,W\,N \times c\,N = \frac{A\,W\,P \times c\,P \times 0.00001}{2 \times c\,N} \div X$$

and in consequence by

$$X = \frac{A\,W\,N \times 0.00001}{2} = A\,W\,N \times 0.000005.$$

The value, X, of necessity signifies:

"The quantity of *negative* matter that is proportionate to the quantity of positive matter disengaged per ampère second."

And this proportion appears in all cases as:

Positive matter (metal) ÷ Negative matter (oxygen) or

$$\frac{A\,W\,P \times P \times 0.00001}{2 \times c\,N} \div \frac{A\,W\,N \times 0.00001}{2}$$

The value $\frac{A\,W\,N}{2} \times 0.00001 \; (= Q_{(1)})$ is therefore in all cases proportionate to the quantity $(= Q)$ of metal disengaged per ampère second. And assisted by theorems of and the knowledge that the combustion of 1 gm. of oxygen is equivalent to 3.030 gm. calories, we can evolve the conclusion that by

$$\frac{A\,W\,N}{2} \times 0.00001 = \frac{15.96}{2} \times 0.00001 = 0.0000798 \text{ gm.}$$

of oxygen, the corresponding caloric effect of the combustion of the quantity $Q_{(1)}$ of oxygen is as caloric effect of $Q_{(1)} = 3.030 \times 0.0000798 = 0.241794$ gm. calories.

And again by 1 kgm. m. = 2.36108 gm. calories, and by

$$\left.\begin{matrix}1 \text{ watt} = \\ 1 \text{ volt-coulomb}\end{matrix}\right\} = \left\{\begin{matrix}\frac{1}{g} = \\ ?\,\frac{1}{9.81} =\end{matrix}\right\} = \left\{\begin{matrix}0.101937 \text{ kgm.m.} = \\ 0.24068 \text{ gm. calories.}\end{matrix}\right.$$

we find one volt-coulomb = 0.24068 gm. calories. It thus appears that (this discrepancy being accounted for by the impression of the value g) this value of 0.24 calories belongs to both the one watt and to the effect of combustion with so much oxygen $(= Q_1)$ as is equivalent to the quantities $(= Q)$ of metal electrolytically disengaged per ampère-second.

In the preceding table* it has been shown that

$$\frac{\text{atomic weight of metal (= chemical equivl't)}}{2\,\frac{c\,N}{c\,P}} = \left\{\begin{matrix}\text{electrolyt. equivalent.} \\ = \frac{A\,W\,P \times c\,P.}{2 \times c\,N.}\end{matrix}\right.$$

and that

$$\left.\begin{matrix}\text{electrolytic equivalents} = \\ \frac{A\,W\,P}{2\,\frac{c\,N}{c\,P}} = \frac{A\,W\,N}{2}\end{matrix}\right\} = \left\{\begin{matrix}+ \\ Q \times 10{,}000 \\ \div \\ - \\ Q_{(1)} \times 10{,}000\end{matrix}\right.$$

And the true meaning of these equations is that the ampère-second, when considered in its effect or quantity of metal disengaged, is not a valuation for the ampère as such but a valuation for the pressure of one volt on a current of one ampère-second, and vice versa, in which valuation the ampère-second is a coefficient of the electric pressure "volt" only, and vice versa.

It may then be said that the energy produced by the combustion of $Q_{(1)} = \frac{A\,W\,N}{2} \times 0.00001$ gm. of oxygen is equivalent to the electrical pressure required for decomposing the compound containing the quantity of negative matter,

$$Q_{(1)} = \frac{A\,W\,N}{2} \times 0.0001,$$

and containing the quantity of positive matter relating thereto, as

$$Q = \frac{A\,W\,P}{2} \cdot \frac{c\,P}{c\,N}$$

And such energy is properly expressed analagous to $C \times R = E$, as a product of

$$10{,}000\,Q \times 2\,\frac{c\,F}{c\,P} = A\,W\,P.$$

$$\left.\begin{matrix}\frac{A\,W\,P \times c\,P}{2 \times c\,N} \\ \text{or the electrolytic equivalent}\end{matrix}\right\} \times 2\,\frac{c\,N}{c\,P} = A\,W\,P$$

$$\text{or } \frac{\text{electrolytic equivalent}}{Q} \text{ ampères} \times 2\,\frac{c\,N}{c\,P} \text{ volts} = \left\{\begin{matrix}\text{E. M. F. decomposing } A\,W\,P \\ \text{from its compounds.}\end{matrix}\right.$$

*See THE ELECTRICAL WORLD of July 23, 1892.

This expressed in words would read: The electrical pressure conditional to electrolytic action, regardless of what conductors demand, is for the decomposition of any compound equivalent for $2\,\frac{c\,N}{c\,P}$ in volts relating to such compound.

The preceding table on page 60 shows these values for the volt as the divisor and $A\,W\,P$ to produce the dividend, viz., electrolytic equivalent.

If this relation is accepted as correct, as certainly it appears as nearly as theoretical values correspond with values obtained in experimenting, then we have $R_{(2)} = \frac{2 \times c\,N}{c\,P}$ volts as a positive value in place of the constructive comparative value

$$R_{(1)} = \frac{H\,t}{44{,}759} \text{ volts.}$$

Thomson's Law of Economy.*

BY E. T. CARTER.

Every electrical engineer is familiar with the law of economy in electric power conductors enunciated by Lord Kelvin, and known as Thomson's law. By means of it the best section to give any cable can be calculated, the extra cost involved by the addition of another pound of copper and the saving of power caused by its addition being all the data necessary to the calculation. It is not, perhaps, so generally known that this law is much more far reaching in its influence than is involved in its special application to power cables. Not only in the cable, not only for electric power, but wherever power is transmitted or transformed this same law of economy is in operation. Apart from questions of strength, successful design of every form of engineering machinery depends upon the proper recognition of the relationship—the antagonism, as it were—between prime cost and working costs which is expressed by the terms of this law. If we diminish the prime cost, we must expect to get an increase in the working costs; and there is a particular value for the prime cost, at which the annual expenses, together with the interest on the prime cost, will be a minimum. Such is the law, and it is eminently a shareholder's law. No engineer can afford to disregard it; but, whether he is designing dynamos and motors, turbines and water-wheels, or steam engines and boilers, he must take it into account.

With electric power cables we have accurate data enabling us to put the law into exact mathematical form; but in many cases the coefficients are wanting, and only a general application of the principle is possible. Yet experience supplies what abstract mathematics is unable to afford, and indicates the most economical conditions in each particular design. With experience, however, a more elastic range of practice is found than would be permitted by an exact knowledge of the coefficients in each case. Let us glance at some of the instances in which an electrical engineer is concerned with the operation of this law. To begin with, it enters into the consideration of the size of the boiler plant, with the flues and chimney attached to it. If we spend more money on bricks and labor and put up a higher chimney, we shall increase the furnace draught, and burn more fuel on each square foot of grate. A higher temperature in the earlier parts of the flues results, and a corresponding improvement in the evaporative efficiency. The annual coal bill is reduced by the extra few feet of chimney. But there is a limit to this practice, beyond which it ceases to be economical; for the extra load of bricks and the labor of building it become more expensive than the coal which is saved, while the increased furnace temperature results in more rapid deterioration of the boiler plates. Experience has fixed the economical limit to the height of the chimney for any given size and type of boiler plant. Again, by allowing the furnace gases to escape at a higher temperature, we can get along with a shorter and cheaper chimney without reducing the draught. The boilers will require less heating surface per horse power, and will therefore be smaller and contain less metal. This economy in the chimney, the boilers and the space for the boilers to stand on, is met by an increase in the working costs; for more heat is thrown up the chimney, the evaporative efficiency of the fuel is lowered, and the coal bill swells to alarming dimensions. There is a particular temperature at which it is most economical to send the gases up the chimney, and long experience has shown that if no economizer is used the gases should escape at about 600 degrees Fah., while if an economizer is employed we may cool them to about 400 degrees Fah. Whether we use an economizer or not should be determined by similar considerations. The cost of the economizer and of the extra feet of chimney it will involve on account of its flue friction, must be set off against the saving in fuel and the reduction in boiler depreciation and repairs—owing to hot feed—which it involves. In either case it is found to be false economy to reduce the boiler heating surface below 3½ square feet for each pound of coal burned per hour, when chimney draught is used.

The boiler steam pressure is regulated by this, law *i. e.*,

*From *The Electrician*, London.

there is a limit beyond an increase of pressure is actually wasteful. With increased pressure the efficiency of the steam engine is increased, but that of a given type of boiler is lowered, while the prime cost of both is increased. For, with high r pressures, thicker boiler plates are necessary for both internal and external heating surfaces, and the thermal conductivity of these surfaces is lowered. Either, therefore, the heating surface must be very much increased, making the boiler more expensive, or the efficiency will be very much reduced. In the steam engine a higher pressure involves a higher ratio of expansion if the steam is to be used economically, and this cannot be carried out in one cylinder beyond a certain limit, without canceling its advantage by the rapid liquefaction which occurs at every stroke. High pressures therefore involve compound, triple and quadruple expansion engines, which are primarily more expensive, per horse power, than single cylinder engines.

Similar conflicting conditions regulate the point of cut-off, and the piston speed of single cylinder or other engines. If we permit an earlier cut-off of steam we shall, up to a certain point, increase the economy of the engine; but we shall also diminish the work done at each stroke, rendering it necessary to build a larger engine in order to get the same horse power as before. We do not, therefore, set our engines to work at the highest practicable ratio of expansion when they are doing their ordinary load, but at some lower ratio, thus sacrificing a small increment in steam economy in order that the size and cost of the engine may not be inordinately large. An engine supplied with steam at 60 pounds, and working with a condenser pressure of 5 pounds, could, if steam-jacketed, work at a ratio of expansion of from 6 to 8 without serious liquefaction. But it would not pay to set the valves at such an early point of cut-off for the ordinary load, for the horse power would be so low that the prime cost per horse power would be much too high a figure. We may attempt to reduce the size and cost of the engine by increasing the piston speed, thus allowing of an earlier cut-off by means of a greater number of strokes per minute. For it is evident that if an earlier cut-off reduces the work of each stroke the horse power may be kept up to its former value by increasing the number of strokes per minute. The prime cost economy of high-speed engines is to be set off against three sources of increased working cost, thus fixing the limit to economical high speeds. Firstly, with rapid expansion there is excessive liquefaction in the cylinder. Steam expanded rapidly expands almost adiabatically, the jacket having little or no time to supply heat to the cylinder steam. Now, the adiabatic expansion of a saturated vapor is necessarily accompanied with partial liquefaction of that vapor, some of it giving up its latent heat in order that the rest may remain saturated while work is being done on the piston. It is unnecessary to enlarge on the fact that liquefaction in the cylinder is both wasteful and troublesome; and most of the re-evaporation that does take place usually occurs in the back stroke, where it causes a wasteful rise in the back pressure. Secondly, increased piston speed causes increased loss of power, owing to the friction at piston rings, glands, etc. Thirdly, it is more than probable that high piston speeds involve a high rate of depreciation of the machinery; and this is more especially the case where the stroke is short and a high piston speed is produced by a large number of revolutions per minute. Against these considerations, however, the electrical engineer must set off the fact that with high-speed engines, making a large number of revolutions per minute, no wasteful and expensive intermediate gearing is necessary in order that they may run high-speed dynamos. It is probable that a better solution of the problem would be found in the abandonment of high-speed dynamos, *i. e.*, by the substitution of dynamos in which a high peripheral speed of the conductors on the armature is obtained without a very great number of revolutions per minute. The economy of material in dynamos is not a question of a high rate of revolution of the armature, but of high linear velocity of the armature conductors.

These few illustrations may serve to show the importance of the law of economy as a law of engineering design. A little consideration will enable one to see that the question whether one shall add another pound of copper to the cable or dynamo, another load of bricks to the chimney, another hundred weight of cast iron to the engine, or another foot to the diameter of the waterwheel or turbine, is, as far as economical considerations are concerned, determined by the opposite consideration whether the cost of the addition will exceed the capital value of the saving in annual expenses. In other words, *the most economical design in any case is that in which the annual interest on the cost of a small increment of material is just equal to the saving in annual expense which would result from that small increment.*

It must not be forgotten, however, that economy is not the only consideration. If copper were very much dearer than at present, and coal very much cheaper, the economical current density for a power cable, as given by Thomson's law, would be sufficient to make the conductor dangerously hot and perhaps to fuse it. In every case, therefore, the question of economy must be modified by the essential questions of strength and safety. Consistently with the maintenance of a high factor of safety, there are few problems in engineering which cannot be settled on the basis of this law.

NEW BOOKS.

Practical Directions for Winding Magnets for Dynamos. By Carl Hering. New York: Spon & Chamberlain. 1892. 63 pages, 7 illustrations. Price, $1.25.

This is a new edition of Mr. Hering's book written in 1887, and which has been out of print for some time. Applications for it have been so constant that the publishers have brought out a new edition, and many who have sought in vain for a copy for the last two or three years will now be able to secure one. The first edition, of which this is a reprint, was reviewed in The Electrical World of July 23, 1887.

Theory of Heat, by J. Clerk Maxwell. Tenth edition, with corrections and additions by Lord Rayleigh. London: Longmans, Green & Co. 1891. 343 pages, 40 illustrations. Price $1.50.

This little book is a marvelously clear exposition in a thoroughly scientific manner of a subject of supreme importance to the mechanical and electrical engineer. Any intelligent engineer or engineering student who doubts the importance of the subject of heat will be thoroughly convinced of his error after reading the preface and introductory chapter of this admirable book. The names of the author and the reviser are a sufficient guarantee of the accuracy of the work and of its scientific character. In this edition only such correcrions and additions have been introduced as seemed really called for, and Lord Rayleigh expresses the belief that these would have commended themselves to the author. They are, indeed, derived in great measure from Maxwell's later writings.

The first part of the book sets forth clearly the fundamental principles of the sciences of thermometry and calorimetry, as these are regarded as the first and second steps by which our knowledge of the phenomena of heat has been extended. When the registration and comparison of temperatures and the measurement of quantities of heat are fully explained the author takes up the third step, which is the investigation of those relations between the thermal and the mechanical properties of substances which form the subject of the thermodynamics. Then follows a consideration of the fact that of the total intrinsic energy of a system of bodies only a part is available for the purpose of producing mechanical work. The natural processes of conduction and radiation of heat, friction and viscosity, by which energy is rendered unavailable as a source of work, are classed together under the name of dissipation of energy and form this division of the book.

The student who desires to pursue the subject farther than the limits of this little work will find in it an abundance of references to original sources of information, to more extended treatises and to works on special branches of the science of heat.

First Principles of Mechanical Engineering, by John Imray and C. H. W. Biggs. London: Biggs & Co., [1892]. 368 pages, 204 illustrations. Price, $1.50.

This volume, according to a statement made on its title page, is the result of an attempt to provide an elementary book, and to treat the subject as far as possible without the use of mathematics. It goes without saying that in a work of this size many important subjects are left untouched, or are but very briefly referred to. The authors have aimed to explain the various subjects at length rather than to make difficult subjects more complicated by the use of unnecessary formulæ. For advanced students, who are able to deal with formulæ in an intelligent way, their use possesses great advantages. But in a work of this kind, intended for beginners, the authors have rightly surmised that the young student would be much more likely to be frightened away than attracted by mathematical demonstrations.

The work is divided into six chapters, not including a very brief one at the end of the book on the nature of chemical action. In the first chapter the fundamental notions of mechanics are explained, and the units and terms in common use are clearly defined. The subject of mechanical drawing, one of the most important for the beginner in this line of study, is then treated with sufficient fullness to enable the reader to interpret the drawings met with in every day engineering practice. In the next chapter the authors have considered the strength of materials and have succeeded in making what usually proves a very dry subject an exceedingly interesting one. The fourth section of the book, and by far the largest, treats of the sources of mechanical power, including a discussion of muscular force, wind, windmills, water, waterwheels, turbines, weight, falling bodies and springs. The subject of heat and the steam engine occupies the next chapter, and these branches of the main subject are dealt with in a very elementary way. The transmission of energy through couplings, clutches, pulleys and the various types of gear wheels is very completely covered in the sixth chapter, and is so fully illustrated that the student will not find the subject a difficult one to understand a qualification, which might apply equally well to the entire book.

Matter, Ether and Motion, the Factors and Relations of Physical Science, by A. E. Dolbear, Ph. D. Boston: Lee & Shepard. 1892. 334 pages, 35 illustrations. Price, $1.75.

No one fact in physical science is more prominent today than the facts that its theories are rapidly changing from year to year, and even from week to week. It must be admitted that the consideration of this fact does not conduce to the stability or fixedness of one's belief in any of the theories put forth, but it is doubtless true that in most instances careful inquiry will show that the new theories are due, not to an abandonment of fundamental principles once thoroughly established and well grounded, but to an extension or to new applications of these principles, or it may be to a new classification of our knowledge, which will include the new facts brought out by the scientific investigator. The necessity of a new treatment of the science of physics which would show the interrelation of heat, light, sound, electricity, chemistry, etc., as parts of a single science rather than as distinct and independent sciences, has been evident for some time.

This work of Prof. Dolbear's is of that character. The text books have not kept pace with the advance of knowledge; and there is a large body of persons desirous of knowing more of natural philosophy, and especially of its tendency, who have neither time nor opportunity to read and digest the almost innumerable papers on the various branches of physics that appear in the periodical and society literature of the day. To meet the wants of this class this book has been prepared, and "it undertakes to present in a systematic way the mechanical principles that underlie the phenomena in each of the different departments of the science in a readable form and in an untechnical manner." Prof. Dolbear has become convinced that all physical phenomena are reducible to the principles of mechanics, that atoms and molecules are subjected to them as much as masses of visible magnitude, and he has realized that, however, different one phenomenon is from another, the factors of both are the same—matter, ether and motion.

The chapter headings, of which there are 13, will give a good idea of the scope of the work. These are: Matter and its Properties, the Ether, Motion, Energy, Gravitation, Heat, Ether Waves, Chemism, Sound, Life, Physical Fields, Machines and Mechanism.

LITERARY NOTES.

Julius Springer, of Berlin, announces the early publication of the collected papers of Wilhelm Weber. These will be issued in six volumes, as follows: Vol I., "Acoustics, Mechanics and Optics"; Vol. II., "Magnetism"; Vols. III. and IV., "Galvanism and Electrodynamics"; Vol. V., "Wave Theories from Experimental Data"; Vol. VI., "Mechanics of the Human Body." It is expected that two and perhaps three of these volumes will be issued during the present year, and the others will follow at short intervals. The price per volume is not yet definitely announced.

The fourth part of the German quarterly publication known as *Fortschritte der Elektrotechnik* has just been received. This is the fourth year of this excellent publication, which aims to give a classified index of periodical electrical literature, accompanied by brief abstracts of important articles. One of its chief faults is that it is not issued promptly, the present number covering the last quarter of 1890. It would be much more valuable if it were for the second quarter of 1892. This part consists of 345 pages and indexes no less than 1,732 separate articles, the total number for the year 1890 being 6,000.

Callaghan & Co., of Chicago, announce an important book on electricity from a legal standpoint, entitled "Electric Wires in Streets and Highways"; a discussion of the laws relating to the use of streets and public highways for lines of electric wires, overhead or underground, by Edward Q. Keasbey, editor of the *New Jersey Law Journal*. The discussion includes the rights of the public and owners of abutting land with respect to the occupation of city streets and country roads for the telegraph and telephone lines, electric light wires and the overhead wires of the electric railway; and also the rights of telegraph companies under the act of Congress and at common law to stretch their wires along the railroads. The author discusses the underlying principles, and also gives a full account of all the cases (some of which have never been reported) bearing directly upon the subject of electric wires in the streets.

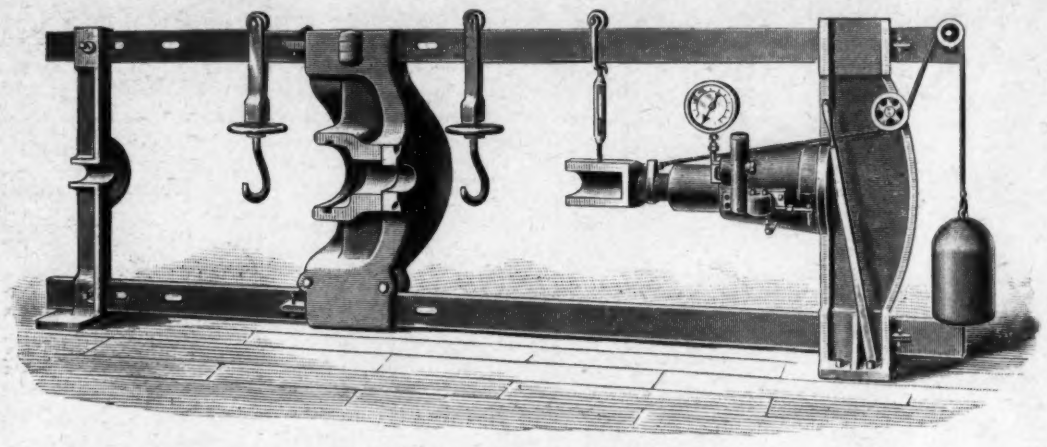
Long Distance Electric Power Transmission.

The most important electric power transmission plant yet undertaken in this country is one now in course of construction for the San Antonio Electric Light and Power Company in Southern California. The power plant is located in the San Antonio Canyon, where there is a minimum flow of 1,300 cubic feet of water per minute, affording a head of about 400 feet. The water is brought to the power station through 1,900 feet of 30-inch and 600 feet of 24-inch double riveted sheet iron pipe, which involves a loss of head by friction of 12 feet, leaving 390 feet effective head or running pressure. The laying of the pipe line necessitated a rock tunnel 1,300 feet in length as well as several heavy open cuts. The power station is provided with four double-nozzle Pelton wheels 34 inches in diameter coupled direct to the armature shafts of as many Westinghouse alternating current generators of 200 h. p. each. The wheels will run under these conditions 600 revolutions per minute, giving the same speed to the generators. Two exciters are provided which are also run by Pelton wheels coupled to the shafts in the same manner, of 20 h. p. each.

The current thus generated will be carried on two No. 7 bare copper wires seven miles down the canyon to a point

where they diverge, one running to Pomona, 15 miles, and the other to San Bernardino, 28 miles, covering by the return circuit in the latter case a distance of 56 miles. By means of transformers the potentials will be raised at the generating station to 10,000 volts and the current carried at this pressure to sub-stations located just outside the cities named, where by means of step-down transformers it will be reduced to about 1,000 volts and then distributed for both light and power purposes.

The motors used will be of the Westinghouse synchronous type. The sub-stations will be provided with regulators by which means the attendant can regulate the voltage of the distributing circuit independently of the generating plant. The necessity of pressure wires upon the system will be obviated by the use of an ingenious device known as the compensator. This installation is attracting much attention, as it is by far the highest tension distributing system ever attempted in this country on so extensive a scale for commercial pnrposes. There is, however, no occasion for any misgiving as to results, though it be a long step in advance of anything heretofore accomplished in this direction. The reputation of the firms supplying this equipment, the Westinghouse Electric and Manufacturing Company and the Pelton Water Wheel Company, is a guarantee of the success of any enterprise they may undertake.



HAND POWER WHEEL PRESS.

The Sturtevant Automatic Double Inclosed Engine.

We present in the accompanying cut a unique design in the way of upright engines suitable for general work, but specially designed for fan propulsion and electric light work. These machines are manufactured by the B. F. Sturtevant Company, of Boston. The bed upon which the engine rests is well spread, very heavy, and is so designed as to give the engine a substantial foundation. The body of the engine is built in two parts, the upper part consisting of the cylinders alone, which may be readily removed for re-oiling. It will be seen that this makes a convenient arrangement in case repairing of either the cylinders or the valve seat is needed.

The valve is of the piston type, and supplies both cylinders by a special arrangement of parts. The design of the crosshead is readily seen, it being of the slipper guide type, running upon a steel slide bar attached to the back of the frame. The connecting rod is very substantial, being of the marine type with large crank-pin bearings. The crank itself is carefully counterbalanced, and all moving parts are made as light as is consistent with the heavy duty which is placed upon the engine. The regulation of the engine is secured by means of a shaft governor acting through a single eccentric to change cut-off from zero to seven-eighths stroke. The oiling of the engine has had special attention, and the oilers are all collected together and connection to the various bearings made by means of tubes. By means of the doors shown the entire engine can be tightly inclosed, preventing the admission of dust or the throwing of any oil upon the running parts. This is a prominent feature of the engine, as it assures continuous running in dusty atmospheres.

As the cylinders are placed side by side in the same casting, the cranks set opposite at an angle of 180 degrees and steam admitted simultaneously at the top of one cylinder and the bottom of the other, the reciprocating parts are balanced in their movements and high speed is made possible. The cylinders are of large diameter as compared with the stroke, so that a large amount of power may be developed at high rotative but moderate piston speed. By the omission of the band wheel and the bed beneath the engine, it may be placed upon a frame casting and connected direct to the shaft of a moderate speed dynamo.

STURTEVANT DOUBLE INCLOSED ENGINE.

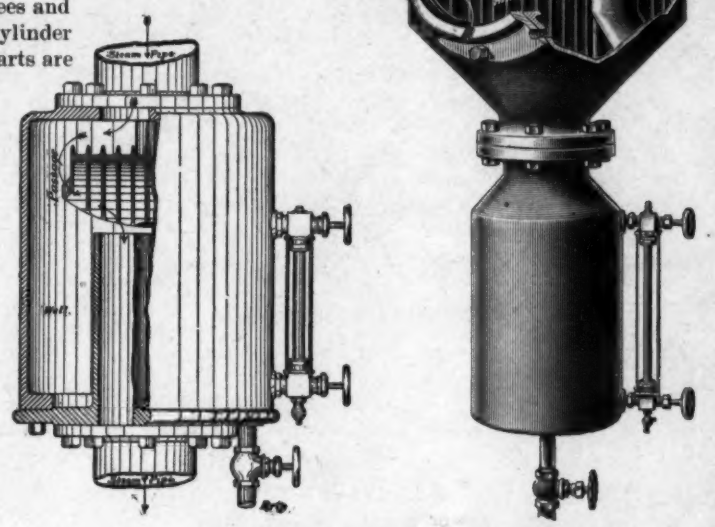
Hand Power Wheel Press for Electric Railroad Work.

Those styles of electric street car motors, like the Westinghouse and Short systems, which have the armature upon the axle of the truck, by reason of the small distance from the hub of the wheel to the end of the armature, do not admit of the use of the ordinary styles of wheel presses when taking off the wheels. For this purpose Watson & Stillman, of New York City, have designed the style of hand press shown by the accompanying cut. The press, except in the shape of the moving abutment, is similar to their standard style. The moving beam rolls upon the lower tension bar, and also has one side roll upon the upper beam to avoid friction caused by the overhanging at the back. Two independent adjustable shaft-carrying hooks are furnished to avoid the "kicking up" of the shaft when placing it in the press. The chuck and abutment beam block act as distance gauges when putting on the wheels. The chuck which is attached to the ram by a centre pin and supported by a rolling carrier, is replaced by a small block when taking off the wheels. Return weights, water tank and pressure gauges, with safety couplings, are furnished with all presses. The hydraulic part is the company's most reliable and convenient style of large jack. The lever works perpendicularly and at right angles to the line of the press, and convenient for the operator to easily watch the work. The piston is entirely closed, thus preventing all grit or foreign material getting into the pump and cutting or preventing its working. The cylinder is made from crucible steel and has a good bearing on the stationary beam.

STANDARD FAN AND MOTOR.

The Cochrane Separators.

The Cochrane separator for horizontal pipes, shown in the accompanying illustration, consists of a cast-iron casing, having opposite lateral openings near the top for the ingress and egress of the steam. The upper section is divided by a baffle plate, having parallel corrugations or ribs extending vertically from top to bottom, with two equal openings, one on each side next to the casing, of a combined area 25 per cent. greater than the area of the entering pipe. Surrounding and guarding that portion of the baffle cut away on each side for the steam passage is a special deep rib to prevent water from flowing or being driven through by the current of steam.



THE COCHRANE SEPARATORS.

The separator for vertical pipes as illustrated differs from the horizontal form in having openings at the top and the bottom for the ingress and egress of steam, and in using the angular baffle plate, which plate is also provided with ribs to break up and divert the entrained water and oil from the current of steam, on the same general principles as those employed in the horizontal style. The well is formed by casting on the bottom piece of the separator a pipe projection, which rises to the lower edge of the baffle plate. These separators, in sizes from 1¼-inch upward, are manufactured by the Harrison Safety Boiler Works, Philadelphia, Pa., under patents granted Feb. 4, 1890, and May 3, 1892.

The Standard Fan, Motor and Battery.

A very neat combination of fan, motor and battery, which is manufactured by the Wright Universal Electric Company, 26 Whitehall street, New York, is shown in the accompanying cut. The whole is as portable and as ornamental as a piano lamp. The case and standard is made either in silver plate or brass. It is designed for use in dining rooms, parlors, libraries, etc. The battery is inclosed in the base and consists of four compartments in one rubber cell. Each compartment contains one and one-quarter pounds of electric sand and three pints of water, in which are placed the carbons. Immersed in this is a porous cup containing zinc and pure water. High electromotive force and long life are claimed. The current is controlled by a switch on the top of the base.

EXHAUST PIPE HEAD.

Robertson's Condenser and Exhaust Pipe Head.

The accompanying illustration represents a very useful article which has been put upon the market by Hine & Robertson, 57 Cortlandt street, New York. It is intended to be placed over the head of an exhaust pipe, and the principle of its construction can be readily seen from the cut. It is strongly constructed of galvanized iron, and combines effectiveness with absolute freedom from back pressure. It

prevents the roof from becoming coated with oil and water, and it is claimed that it saves enough repairs in this way to many times pay for itself.

Device to Prevent Belt Slipping.

The slipping of belts has always been a source of considerable waste of power. In electrical works this trouble is especially noticeable, and in addition to the actual loss of power often causes serious inconvenience to the customers as well as the company. The device which is illustrated in the accompanying cut is claimed to be a complete remedy for this. Its construction is obvious. A rubber belt with flutings or corrugations molded into its inner surface runs over a pulley cover or tire of the same material, and

Device to Prevent Belt Slipping.

with a corresponding corrugated surface. This cover can be applied to any pulley, wood or iron, new or old. Not only is slipping obviated, but as the belt runs on an elastic surface the friction is lessened, wear prevented, and the life of the belt prolonged. The manufacturer of this article is the Mineralized Rubber Company, 18 Cliff Street, New York.

The Franklin Electric Company's Storage Battery.

Any improvement in the accumulator or secondary battery is always looked upon with interest. Efforts to improve the form which is prevalent to-day have been made in various directions, but with only partial success. The Franklin Electric Company, of 106 Liberty street, New York, claims to have solved some of the difficulties in the new battery which it is now placing on the market. This battery, although not entirely new in its construction, is quite a radical departure from the ordinary lead accumulator. It might be said to be a secondary battery with a primary action. The negative plate is woven in one piece of copper cloth, which is coated with an amalgam which oxidizes under the action of the discharging current and between the folds of this copper gauze are placed thin zinc plates; the positive plate consists of an alloy of lead containing a very small percentage of silver. This takes the form of a wire bent back upon itself a number of times so as to present a relatively large surface and is in as many

FIG. 1.—THE FRANKLIN STORAGE BATTERY. FIGS. 3 AND 4.—THE FRANKLIN LARYNGOSCOPES.

sections as there are porous cups, all joined together at the top by a good conductor. This is immersed in porous cups of biscuit ware containing a semi-liquid paste prepared by a special process. The whole, including the plates and porous cups, is placed in a wooden case lined with an eighth of an inch of paraffine containing another special solution.

It will be seen that the chemical action of this battery is entirely different from that of the common form of cell. In charging the positive plate is oxidized and amalgam deposited on the negative, and on discharging the negative is oxidized and hydrogen deposited on the positive. All danger of buckling is avoided and there is no trouble about active material falling out of grids and short-circuiting the plates, difficulties which are incident to the lead accumulator. As to charging and discharging it is claimed that the rate is quite immaterial as regards its effect on the life and efficiency of the cell, which is one of the prominent features of this battery. The light weight is

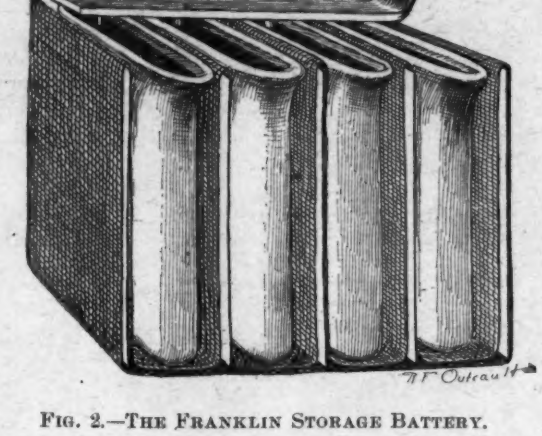


Fig. 2.—The Franklin Storage Battery.

another important feature, 72 pounds total weight per horse power output being claimed.

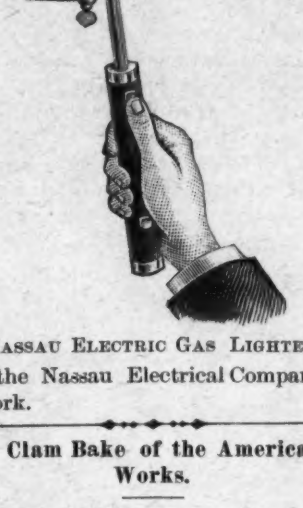
Fig. 1 shows a complete 24-ampère cell and Fig. 2 the plates and cups. The electromotive force is 2.4 volts or 2.6 volts on open circuit. The discharge rate is anywhere from 5 to 60 ampères. The cell is sealed in with paraffine. A special feature is the controlling mechanism on the cover. It will be seen that the terminals are connected to the hinges, and thence to the binding posts. Between one hinge and post is inserted a small rheostat consisting of German silver wire wound on a cylinder covered with asbestos. A metal piece sliding along the cover on a rod and secured by a thumb screw cuts in or out resistance, as may be desired. The whole arrangement is very neat, and the cover of the box can be closed and locked, and the cell carried about with as much convenience as a case of instruments. It is intended especially for a physician's outfit for cautery, systoscopic, endoscopic and electrolytic work. The dimensions of the case are $4\frac{5}{8} \times 5\frac{1}{4} \times 7$ inches.

In this connection the company has devised the two instruments illustrated in Figs. 3 and 4, designed for the use of physicians and dentists. In both instruments a tiny electric lamp is attached to the end by a ball and socket joint which permits the lamp to be moved about in any direction during an operation without the removal of the instrument. The instrument shown in Fig. 4 is provided with a broad plate so shaped as to hold the patient's tongue in place, a very important feature.

The Franklin company manufactures cells of various sizes adapted to electric lighting, traction, heating, propulsion of launches, etc.

The Nassau Electrical Gas Lighter.

A very convenient and effective device in the form of a gas-lighter is shown in the accompanying illustration. This is only rendered possible by the use of batteries so small as the Nassau capsules. This lighter is 23 inches long, and contains two Nassau capsules and a sparking coil concealed in the handle. It is claimed to be certain of action under all conditions. Its portable form commends it. It is manufactured by the Nassau Electrical Company, 112 White street, New York.



Nassau Electric Gas Lighter.

The Annual Clam Bake of the American Electrical Works.

The one festive day of the year to the electrical fraternity is that on which Eugene L. Phillips gives the "boys" an opportunity to enjoy themselves at the annual clam bake at Providence. This occurred on Saturday last, when over 200 representatives of the franternity assembled to enjoy Mr. Phillips' hospitality. The day was a pleasant one for such an outing and. as anticipated, the "bake" was a successful one. Mr. Phillips himself was in the best of spirits. The d y was spent in base ball and foot ball playing, rifle shooting, and other athletic games. Just before the dinner the entire party was photographed by a Providence artist. The after dinner speeches by Governor Brown, of Rhode Island; Eugene L. Phillips; Judge McLeary, of Texas; M. C. Day. of the Providence *Journal*; ex-President Chas. R. Huntley, of the National Electric Light Association; C. W. Hagar, of Montreal, and others were brief and to the point. Chas. W. Price, of New York, acted as toastmaster. A handsome crayon portrait of Mr. Phillips was presented to him and was accepted in a brief speech.

The official register showed the following attendance:

Providence: J. O. Darling, G. H Darling, A. Wright, R. Fessenden, W. H. Sawyer, S. L. Stump, H. P. Crowley, W. W. Dempster, E. R. Phillips, H. C. Langstaff, S. L. Thurston, E. C. Hughes, A. D. Saynard, W. J. Thurston, M. C. Day, J. W. White, C. A. White, H. G. Wright, G E. Andrews, G. H. Thurston, W. H. Clewley, R. Wesser, E. M. Carhart, W. D. Wright, A. C. White, H. C. Bradford, Gov. D. R. Brown, C. G. A. Peterson, J. S. Knowles, C. R. Pennington, Jr., B. F. Lovett, W. N. Monro, W. I. Barnes, R. F. Capwell, J. A. Magoon, C. W. Russell, V. A. Thomas, W. A. Hathaway, T. R. Payson, B. N. Whitaker, and E. A. Smith.

Boston: M. S. Key, H. M. Ballard, E. P. Morris, M. W. Brown, A. O. Smith, L. S. Dumoulin, C. L. Ring, H. F. Woods, C. S. Bly, G. Clarke, F. A. Swan, D. A. Harrington, S. B. Condit, Jr., C. A. Baldwin, A. T. Baldwin, W. R. Waters, J. H. Studley, G. H. Bucksmith, C. W. Wolcott, G. L. Austin, W. J. Hazel, S. A. Richardson, J. Taylor, J. H. Leonard, H. B. Cram, P. Fahey, A. C. Shaw, C. W. Card, E. R. Tilton, A. A Ziegler, C. B. Burleigh, C. E. Bibber, T. H. Bibber, C. B. Price, C. A. Clark, H. M. French, E. E. Carey, F. S. Palmer, J. H. Clark, F. Gould, Jr., J. L. Lucas, W. E. Durgin, W. A. Carey, C. N. Wood, J. P. Felton, A. B. Field, J. P. Loring, C. S. Haley, R. W. Smith, W. I. Hill, G. H. Dunn, F. M. Kimball, I. O. Wright, W. A. McKenney, J. A. McCoy, R. F. Ross, C. W. Holtzer, F. Ridlon, N. W. Lillie, S. Smith and C. H. Herrick.

New York: H. W. Pool, L. H. Hart, T. R. Taltavall, E. E. Wood, D A. Patten, G. Smith, F. Pearle, W. T. Hunt, G. F. Porter, P. C. Ackerman, J. C. Pierrez, B. F. Hamilton, H. E. Monk, C. O. Baker, Jr.; C W. Price, D. Chalmers, J. A. Cooney, J. F. Carney, A. G. Oakley, R. Mace and E. Caldwell.

Bridgeport, Conn.: R. C. Breck.

Milbury: R. C. Morss.

Narragansett Pier, R. I.: S. L. Miller.

Haverhill, Mass.: G. Calef.

Fall River, Mass.: C. Sylvester, W. E. Tanner and G. G. Gruish.

Auburn, R. I.: H. H. Thurmain.

Worcester, Mass.: H. H. Fairbanks, W. H. Coughlin and W. S. Townsend.

Newark, N. J.: D. Farand and C. H. McIntire.

Rochester, N. Y.: F. D. Hotchkiss.

Whitinsville, Mass.: G. Wilmot and M. P. Burbank.

Marlboro, Mass.: A. de Khotinsky.

Waterbury, Conn.: A. M. Young and A. O. Shepardson.

New Britain, Conn.: D. C. Whitney and G. P. Hart.

Pawtucket, R. I.: N. B. Dennison, J. E. Andrew, J. A. Jenney, A. E. Jenney, J. Brown, W. H. Hodges, C. H. Bullock and O. Smith, Jr.

Leicester, Mass.: W. F. Whitman.

Buffalo: C. R. Huntley and C. L. Abell.

Putnam, Conn.: J. B. Tatem.

Manchester, N. H.: T. W. Lane.

San Antonio, Tex.: J. H. McLeary.

Montreal, Can.: C. W. Hagar and J. Carroll.

Elizabeth, N. J.: G. S. Hamilton and S. Hurlbut.

Philadelphia, Pa.: H. J. Curl, H. Blentler and A. R. Raymond.

Pittsburgh, Pa.: M. W. Mead and W. Martin.

Lynn, Mass.: L. S. Urquhart.

Lowell: H. R. Rice, C. S. Hylan, C. J. Glidden, L. Sprague, F. J. Boynton and S. Young.

New Haven: A. H. Embler, E. B. Baker and E. B Clarke.

Newport, R. I.: F. E. Johnson and H. J. Lockrow.

Hartford: W. H. Babcock, M. E. Baird, D. P. Colton and G. D. Johnson.

New Bedford, Mass.: W. K. Wagner and W. R. Shuman.

Bristol, R. I.: J. B. Peare.

Taunton, Mass.: A. Coleman.

Riverpoint, R. I.: R. I. S. Brock.

Chelsea, Mass.: F. M Gilley, and E. A. Chapel,

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, July 23, 1892.

New York General Financial Market.—Wall street during the first part of the week was lifeless. The news of the contemplated adjournment of Congress next week which reached here Tuesday night, infused a little activity into Wednesday's market, a movement that was accelerated Thursday by traders in Industrial stocks. American sugar refinery stock was selected as the balance wheel, and moved upward about five points; a number of other Industrials participated. Thursday gave promise of a very active market. Yesterday and to-day the market just held its own, showing a slight general advance for the week. Experts report an improvement in the volume of trade throughout the country. Crop prospects have materially improved, gold exports have been checked and treasury gold balances have increased. Bank clearances declined somewhat as compared with the corresponding week of last year, but have increased in comparison with the preceding week. Money is easy in all centres and is seeking gilt-edged investments.

New York Electric Stock Market.—As was predicted in our last report, the news of the adjournment of Congress infused considerable activity in the Industrials, in which the electric stock was the first to participate, leading the list in point of sales and general activity. This is looked upon as indicative of the favor with which they are regarded by investors, who just at this time are unusually cautious in placing money in securities of any nature. We note the sale of the comparatively very large number of the high priced telegraph and illuminating securities, which will be treated in detail elsewhere in this report. Values in almost all cases have advanced, some of the movements being very pronounced and foretelling the course of the stock in a market of general activity. In many cases the buyer and seller have been several points apart, and in consequence there was a large number of inquiries which are not shown in a report of actual transactions. These are all *bona fide* and will doubtless be satisfied when the general movement comes. Another marked and important feature of the market has been the buying for investment. When this is contrasted with the manipulations of professional traders in the other securities of different exchanges, its weight is readily seen. Commercial Cable sold the first time in several weeks, and reached the highest point in its existence, viz., 160, to which figure it jumped on a previous sale at 158½. The news of the Dillon suit against Mackay and Bennett had no effect on the stock except to weaken bids on Monday, which dropped off for the day to 154. American Telegraph & Cable was in quite good request, and met with few sales at 86⅛ to 87. American District Telegraph was active through three days of the week and and scored ¾ of a point, closing at 63. North American was neglected by insiders, and consequently the general public—which just at the present time is a myth in the Street—are inclined to let it severely alone. The other more active stocks are treated under separate heads.

Boston Financial Review.—The market of the week has maintained its strength rather at the expense of activity, and this would seem to indicate that the short interest is growing less. Two successive days seem to be the limit for any marked activity and rise in values, and then follows a day or two of corresponding dullness, but the undertone of strength does not change. Indications and predictions all favor a rising market, as the influences that have naturally retarded the upward movement are gradually disappearing. Gold shipments have about stopped; labor troubles are being adjusted; Congress is on the eve of adjournment, and indications of particularly favorable crops are evident upon every hand in the West. London is not a great factor at present in our markets, for the trading is of a very small volume, and inclines toward the buying side of the sheet, helping our prices upward, and the strength of all the principal stocks is by no means discouraging for a good fall market. Money is again more plentiful than the demand for it, and rates have fallen to their lowest point. Between the banks the rate is 2 to 3 per cent. Time and call loans bring 3 to 5 per cent. Municipal bonds furnish a much better channel for money than short loans, and every issue is taken without any delay.

Electric Stocks in Boston.—The electrics maintain their strength and show a good use in some cases. The new General Electric Company stock is the most attractive, and has made a good advance over last week. The loose stock is gradually being absorbed, and when entirely taken from the market much higher figures will follow. It is known that all the available stock is being bought for investment, and will not be seen again on the market until existing conditions are materially changed. There is to-day no better investment offering than in this stock, and the public appreciate its value and its backing. Talk of further consolidation with Nightingale and Fort Wayne continues, but has no credence. Westinghouse stock is flat and doing absolutely nothing. The company's reports show that it is evidently working along in the even tenor of its way, doing a good business and adding value to the stock, whether the market price reflects it or not. Fort Wayne maintains its usual strength, and there is evidently a feeling to buy and put it higher, but it moves very slowly while its position toward the General Company is so uncertain. Thomson-Houston sales are growing fewer with each week, as the stock is nearly all exchanged by this date. Detroit electric stock has shown its only activity in some months, but there is as yet no material change for the better in price. Telephone stocks are quiet and practically unchanged. Edison Electric Illuminating Company has sold in small lots at upward of 117 to 118 dividend off.

General Electric lead the first active week since its connection with the New York Stock Exchange. Values advanced from 109 to 111½ divided on, and later in the week to 109 ex-dividend. The orders were in 100 share lots, quite numerous and are pronounced to have been investment orders. If the stock takes a start through this buying speculators will not be slow to adopt it as a medium for a turn, and the result will be a very active market. Its debenture 5's were in good demand; 38,000 sold at 99¾ to 99⅞, and if the inquiry continued will without doubt reach par next week. The company has listed $4,000,000 5 per cent. gold debenture bonds of 1922. These are a part of the $10,000,000 authorized. They are convertible in the full paid common stock on the basis of $120 of bonds for $100 of stock. A million and a half of the proceeds of these bonds has been used toward extinguishing the floating debt, and it is intended to use the balance for the same purpose, either directly or by the purchase from the companies of the stocks and bonds or other securities held by them. Should a mortgage be created during the life of this bond the holder will be entitled to receive in exchange for the debenture a mortgage bond for the same principal and bearing interest as therein expressed. The band circular of Lee, Higginson & Co., of Boston, for July notes concerning the General Electric Company states that its total authorized capital is $50,000,000, of which $10,000,000 is 7 per cent. cumulative preferred stock, of which $4,136,300 has been issued. Common stock issued, $30,067,200; total authorized 5 per cent. bonds, $10,000,000; issued $4,000,000.

The Union Elektricitats Gesellschaft, of Berlin, Germany, is the successor of the Thomson-Houston International Company in Europe, and handles the Thomson-Houston interests there just as the International Company did before it. Under contracts with the best manufacturers of electrical apparatus, fire-arms, etc, the Thomson-Houston apparatus is now being manufactured in Berlin, so that it may be handled more advantageously in competition with the European companies of long standing. Continued progress is being made under the plan, and in addition to the electric railway in Bremen, which has been in successful operation over a year, using the Thomson-Houston trolley system and apparatus, contracts have very recently been made for similar equipments of roads in Brussels and Remscheid, and the company is rapidly gaining headway through agents in all parts of Europe.

Edison Electric Illuminating Company, of New York.—This has been the active stock of the electrical list during the week. It started on Monday at 87½, and upon active inquiry advanced to 94½ on Thursday. The demand was created by the news of increased earnings and the general belief that the property is one of the finest in point of earning capacity from the list. It has just listed its recently authorized issue of 5% gold first-mortgage bonds, and 4,000 of these sold yesterday at 102, and a subsequent sale to-day of 10,000 was made at 104. Security experts pronounced these bonds to be worth 110 at the present rates for money. The company has announced that on and after Aug. 2, 1892, it will issue full paid stock certificates in exchange for its convertible certificates of the series of 1890, when presented in amounts of $100, or some multiple thereof; and in accordance with the terms under which these convertible certificates were issued. No interest will be paid on them after that date.

Consolidation of Rochester Electric Companies.—Mr. R. A. C. Smith, 15 Wall street, representing the Consolidated Gas Companies of Rochester, has carried to a successful termination the consolidation of the Edison Electric Illuminating Company, the Rochester Electric Company, and the acquisition of the Brush Electric Company. The consolidated corporation, to be known as the Rochester Gas and Electric Company, will have the following officers; President, J. Lee Judson; vice-president, William Runkle; second vice-president, Frederick Cook; chairman of executive committee, R. A. C. Smith; treasurer, G. C. Archer; secretary, George C. Hollister; assistant secretary and treasurer, H. G. Runkle. The capital is $4,560,000; 2,500 shares of stock are to be preferred, bearing 6% cumulative dividend. The stockholders of the Rochester Gas Company will receive 20,500 shares, of the Edison Company 6,000 shares, and of the Rochester Company 4,000 shares; in each case one-half common and one-half preferred. The directors are authorized to employ the stock remaining in the treasury for the purchase of not less than two-thirds of the Brush Company. The consolidated corporation is to assume the bonds of the companies in the consolidation.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, July 23, 1892, in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding	Lowest.	Highest.	Bid.	Ask'd.
American Bell Tel	100	17,500,000	....	....	....	..½
American District Tel	100	3,825,000	62¼	63¼	60	63
American Tel. & Cable	100	14,000,000	86½	87	87	88½
Central & So. Am. Tel	100	6,000,000	....	....	....	..
Commercial Cables	100	7,716,000	158½	160	157⅞	162
Debentures	...	1,000,000	....	....	....	..
Erie Tel. & Telp	100	4,800,000	....	....	....	..
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds	500	500,000	....	....	100	..
Mexican Tel	100	2,000,000	....	....	....	..
Northwestern Tel	50	2,500,000	....	....	....	..
First Mort. Sinking Fund	500	1,180,000	....	....	....	..
Postal Tel. & Cable	...	10,000,000	....	....	62	64
Southern & Atlantic Tel	25	948,775	....	....	78	84
Western Union Tel	100	15,000,000	93	94⅛	94	94⅛
Real estate bonds	1,000	1,219,000	....	....	....	.
Debenture bonds	1,000	4,920,000	....	....	....	..
" sinking fund bonds	500	841,266	....	....	....	..
Collateral Trust 5's	1,0 0	8,181,000	104	105⅛	....	.
North American	100	39.767,200	13⅜	14	....	....
Brush Ill. Co. of N. Y	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y., ex-right ex-div	100	6,500,000	88	92	92	95
Edison El Il. of Brooklyn	100	750,000	...	....	85	90
" " " " Chicago	100	750,000	....	....	130	145
" " " " Boston	...	.....	....	....	115	125
Edison El. Lt. Europe	1,000	2,000,000	....	....	2	6
" Bonds	...	30,000	....	....	65	80
Edison Ore Milling Co	...	2,000,000	....	....	15	20
East River El Light	100	1,000,000	....	....	..	65
General Electric ex-right ex-div	1,000	50,000,000	109¼	107¾	109⅛	109¾
Automatic Exhibition Co.	...	2,500,000	...	....	3	5
Mt. Morris Electric	...	500,000	....	....	....	65
N. E. Phonograph	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	5
North American Phonograph	...	2,000,000	....	....	4	6
Westinghouse Elec & Mfg. Co. 1st p. 7 per cent. Cum	50	3,717,253	....	...	....	....
E. & M. Co. Assg	50	5,038,116	53½	....	....	..

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec	25	6,000,000	67	65¼	65½	66
Thomson Houston Elec. preferred	25	4,000,000	30	29¾	29¾	30
Thomson-Houston Elec.—Series C	sh	40,000	....	....	8⅛	9
Thomson-Houston Elec.—Series D	sh	120,000	7⅜	7¼	7¼	7½
Thomson Elec. Weld	100	1,000,000	....	....	45	....
Thomson European Elec. Weld	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com	..	6,000,000	28	28	27¾	28
Westinghouse Elec.—Pfd	..	4,000,000	46	44½	45½	46½
General Electric	..	30,067,200	111½	108⅝	109	109½
" " Pfd	..	4,136,300	120¾	118	119½	120
Fort Wayne Elec	25	4,000,000	12¾	12½	12⅜	13
Fort Wayne Elec.—Ser. A	sh	80,000	7⅛	....	7¼	7½
Detroit Elec	10	1,000,000	7⅛	7	7	....
West End St. Ry. Co.—Com	50	7,150,000	73⅞	72⅜	73⅜	74
West End St. Ry. Co.—Pfd	50	6,400,000	88¾	88	88⅜	88½
American Bell Tel	100	15,000,000	204	203	203	203½
Erie Tel. & Tel. Co	..	4,800,000	17¼	46½	47	47¼
Mexican Tel. Co	10	1,280,000	....	....	1.02⅛	....
New Eng. Tel. & Tel. Co	..	10,304,600	56	....	....	56
Tropical Tel. Co	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	224	..	Chicago Arc Light & Power Co	98	99
Central Union	56¼	58	Chicago Edison Co.	165	..
Iowa Union	20	25			
Michigan	88⅛	92			
Missouri & Kansas	58	65			

Western Union.—This stock, while it has closed an advance about one point in value, has not been active as usual in transactions. The fact is probable due to the attention of S. V. White and others, who have been its chief manipulators, to sugar and certain railway securities. There was a heavy demand for its Collateral Trust 5's. These sold during every day, starting at 104 and closing at 105⅛, 15,000 being traded in. Rumors of the sale of the control of this company to English capitalists are still rampant in the street, but are not generally credible.

The Chicago Telephone Company has announced that it will issue $500,000 new stock at par to holders of record of Aug. 5. The present capital stock of the company is $2,260,000, but the new issue will increase the total to $2,760,000. It is stated that at the present selling price for the stock rights will be worth about $27.50 on each share of the stock. The proceeds derived from the new issue will be used to extend the plant, more particularly in the World's Fair district. The stock latterly has been strong on a knowledge that a new issue of stock was to be made at par. This week a block of the stock changed hands at $225.

Dividends.—The Edison Electric Illuminating Company, of Boston, have declared a quarterly dividend of 2 per cent, payable Aug. 1.

The Copper Market.—There has been a slight strengthening in the copper market in the last two days, due to a speculative movement on the part of large copper producers who are alleged to have made wash sales in this country and London. The August and September contracts are about to be placed, and these companies realize the importance of working the markets upon as high a plane as possible before that eventuates. Sales of lake were made at the advance of 11⅛ cents. The supplies are going almost entirely to the electrical and sheet works. These different manufacturing institutions claim that they are having all they can do to supply their own orders. Other branches of the copper consuming industry are exceedingly dull. The remaining 3,000,000 pounds of French Syndicate copper was sold this week to parties who are supposed to represent American interests. The exports for the week consisted of 721,000 pounds at 55-9 per cent. matte. As has been the case during the two previous weeks there has been no fine copper sent out, for the reason that the London quotation is below the American.

NEW INCORPORATIONS.

The Platt Electric Company, of Decatur, Ill., has been incorporated with $104,000 capital stock. R. F. Platt, E. E. Gibson, and J. H. Culver are the incorporators.

The Alaska Railway Construction Company, of Chicago, Ill., capital stock $100,000, has been formed to build and construct street railways, electric motors, etc. E. A. Filkins, M. Hewetson and Paul Dickinson are the promoters.

The Stamford Electric Light Company, of Stamford, N. Y., capital stock $20,000, has been formed to manufacture and use electricity for light, heat and power. J. Maynard, S. E. Churchill and E. W. Churchill, all of Stamford, are the organizers.

The Bath Electric Illuminating and Power Company, of Bath, N. Y., capital stock $35,000, has been formed to manufacture and rent electricity to other parties. Wm. M. Sheeham, Walter E. Hyer and Robt. J. Boyd, all of Newburgh, are the incorporators.

The Otis Electric Company, of Yonkers, N. Y., capital stock $350,000, has been formed to manufacture and sell electric motors. Norton P. Otis, Wm. D. Baldwin, of Yonkers, and Samuel Dana Greene, of 204 West Fifty-fifth street, New York, are the promoters.

The Bradley General Electric Company, of Chicago, Ill., capital stock $1,000,000, has been formed to manufacture and sell electric devices and machinery, construct electric railroads, etc. Homer C. Hartman, Edwin S. Douglas and Francis I Furber are the promoters.

The Nanticoke & Newport Railway Company, of Nanticoke, Pa., capital stock $50,000, has been organized to construct and operate an electric street railway from Nanticoke to Glen Lyon. The incorporators are John B. Reynolds, John T. Lenahan and John Smoulter, Jr.

The Fort Madison Water and Light Company, of Fort Madison, Ia., capital stock $500,000, has been formed to hold, own and construct electric light plants, etc. H. R. Russell, C. D. Turney, H. F. James, New York; Wm. J. McCray and C. H. Peters, of Fort Madison, are the incorporators.

The Orange City Electric Light Company, of Orange City, Ia., capital stock $16,000, has been incorporated to erect a plant for furnishing electric lights. M. E. Lewis, E. H. Casjens, A. Vander Meide, John Vandesteey, Jerome Fisher and H. Rynsburger, of Orange City, are the promoters.

The Lemaire Decorative and Electrical Manufacturing Company, of New York, capital stock $200,000, has been organized to do decorative metal work and electric wiring, etc. The The directors are Paul Lemaire, Jacob L. Barclay, William J. Malcolm, Nicholas H. Stovey and Ralph S. Rounds.

The Applegate Electric Light and Power Company, of Chicago, Ill., has been incorporated with a capital stock of $1,000,000, to manufacture and sell electric lighting devices, machinery, apparatus, etc. The organizers are Geo. W. La Rue, Eugene W. Applegate, Elisha R. Nichols, J. S. Palmer and R. B. Gillies.

The Durango Railway and Realty Company, of Durango, Colo., capital stock $250,000, has been formed to construct a system of street railways in Durango, to be operated by electricity or other power, etc. George Ditchfield, S. E. Herr, W. G. White, W. S. Pickrell and J. M. McClockey, of Durango, are the incorporators.

The Columbia Chronophone Company, of Camden, N. J., has been incorporated with a capital stock of $20,000. The object of the company is to manufacture and sell "the electric time and call-back." The incorporators are Richard W. Dorphley, Hammonton, N. J.; Wm. S. Anderson, Wm. H. Brady and J. Emory Byram, all of Philadelphia, Pa.

AFFAIRS OF THE COMPANIES.

The Pettingill-Andrews Company, of Boston, has bought out the Eastern Electrical Supply Company.

The Hartman General Electric Light Company has amended its articles of incorporation and increased its capital stock to $500,000.

The North Highlands (Ga.) Railroad Company at a recent meeting elected the following board of directors: S. A. Carter, E. J. Rankin, Rhodes Browne, J. B. Holst, D. P. Dozier, T. F. Smith and R. A. Carson.

Burlington, Ia.—The stockholders of the Steam Supply Company have accepted the proposition of the bondholders and there is now nothing in the way of the electric light company obtaining possession of the Steam Supply Works.

Jersey City, N. J.—The counsel for the receiver of the United Electric Traction Company reports that the affairs of the insolvent company are rapidly assuming a satisfactory shape, and that there is every prospect that the works at Marion will be reopened in the fall.

The Edison Electric Illuminating Company, of Rochester, the Rochester Electric Company, and the Brush Electric Company have been consolidated into one corporation, to be known as the Rochester Gas and Electric Company, capital $4,300,000, one-half being 6% cumulative preferred.

The People's Electric Light and Power Company, of Evansville, Ind., has elected the following officers: President, C. S. Knight; vice-president, Brainard Rorison; secretary and treasurer, John J. Nolan. The new company will operate what has hitherto been known as the Fort Wayne-Tenney Electric Light Company, with a capital stock of $100,000.

The Gardner Electric Light Company, of Worcester, Mass., has elected the following officers: Clerk and treasurer, F. S. Whittemore; directors, R. L. Bent, C. O. Bent, T. B. Dunn, Henry Heywood, George Heywood, C. F. Richardson, Philander Derby Chas. W. Conant and Augustus Knowlton. The directors have organized with R. L. Bent president and T. B. Dunn vice-president

The Westinghouse Electric Light Company, of York, Pa., is the name of a new company which has been organized in York. A board of directors has been elected and instructions given to take immediate steps to secure a charter with a capital stock of $50,000. The following officers have been elected: President, L. A. Marshall; vice-president, M. M. Aydeman; secretary, Edward Stuck; treasurer, R. H. Shindel.

The Rutland Electric Light Company, of Rutland, Vt., at its annual meeting re-elected the old board of directors as follows: M. J. Francisco, Edson P. Gilson, Justin Batchelder, Henry W. Cheney, W. H. Valiquette, C. E. Ross, F. H. Richardson, A. H. Abraham and I. H. Francisco, of Rutland, and E. I. Garfield, of Boston. The directors organized by re-electing the old board of officers: M. J. Francisco, president; Justin Batchelder, vice-president; I. H. Francisco, secretary, and C. E. Ross, treasurer.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, July 25, 1892.

Putting the Wires Underground.—The report of the Board of Electrical Control for June showed that in that month 62 telegraph poles and 1,011,960 feet of wire were removed in the city.

New Members of the Electric Club.—At a meeting of the board of managers, held at the Club House last week, the following were elected members: J. F. Hughes, Edward Peck, D. A. Patten, Leonard F. Requa, Alex. H. Bauer, J. H. Long, H. J. Stanbaugh, George E. Kent, J. H. Enholm, A. G. Greenburg, Harry S. Marlor, F. H. Leonard, Jr., W. S. Hine, E. W. Seymour.

The General Electric Company's Works at Schenectady were somewhat damaged by fire this morning. The fire broke out in Shop No. 11, where the underground tubing and compound were manufactured, and this was destroyed, but the prompt action of the fire department saved the other buildings. The building was fully insured, and work will immediately be resumed in temporary quarters.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., July 23, 1892.

West & Dixon, of Boston, has recently finished some large orders in ceiling rosettes and electrical molding.

Swan & Lane, general electrical contractors, Boston, Mass., have recently been appointed New England agents for the Jenney Electric Motor Company, of Indianapolis.

O. N. Bender & Co., of Providence, R. I., makes a specialty of cable supporters or hangers, and is meeting with many orders from telegraph and telephone companies in various parts of the United States.

The American Electric Company, sole manufacturer of the New Era gas lighter, is doing a very fair business with this specialty. It is a simple mechanism, and cannot strain the most delicate fixture.

Benedict & Burnham Manufacturing Company, of Waterbury, Conn., manufacturers of bare and insulated copper wire, is meeting with a very lively demand for the new Benedict weatherproof wire.

Murray & Tregurtha, the manufacturers of Tregurtha water tube boilers, are doing a considerable trade with the electrical specialty manufacturers in the die business. They also design and build special machinery.

The Boston Incandescent Lamp Company, Mr. Charles E. Bibber general sales agent, is furnishing the electric light stations and isolated plants with samples of the Boston lamp, so as to give them an opportunity to judge its efficiency.

The Bryant Electric Company, Bridgeport, Conn, the well known manufacturer of the Bryant and Paiste switches, reports that business is steadily on the increase. This company has its western office at No. 1522 Monadnock Building, Chicago.

The Eastern Electric Light and Storage Battery Company, manufacturer of the Sorley storage battery, is meeting with a fair demand. It is making these batteries in different sizes, cased in polished cabinet boxes. Its phonographic trade is steadily increasing.

A. J. Adams, representative of the Jenney Electric Motor Company, reports that his company has sold recently a 50-h. p. machine to Brown & Ketchum, Indianapolis; a 300-light machine to the Denver Water Works; also a 300-light machine to Butler University, Minn.

The Burnham & Duggan Railroad Appliance Company reports business for its street railway chair as very brisk. The United States government test shows that it sustained a load of 78,200 lbs. There are no bolts or rivets, and it can be quickly and securely applied.

The Laminar Fibre Goods Company, Boston, Mass., reports this fibre as thoroughly homogeneous and practically indestructible, a substitute for hard rubber for insulating and mechanical purposes. It can be turned or drilled into any desired shape, and is capable of taking a high polish.

The Electric Heat Alarm Company, Boston, has recently devised a new application for its alarm, which acts as a fire alarm. It is principally intended for use in hotels, dry rooms and mills. In outward appearance the rosettes resemble an ordinary push button, and they can be set for any degrees of temperature. The rosettes are made in three different styles, and the company has so far found that in this branch of its business there is a wide field.

Dynamos for Fire Alarm Systems.—The inspector of wires of the city of Boston, Capt. Brown S. Flanders, has recommended that the electric circuits for the fire alarm system should be supplied by dynamo currents instead of batteries, which are in universal use. The advantages of this change are numerous and apply to nearly every condition that can be considered in the matter, especially in the large amount of room and the attendance necessary in connection with the batteries, and also the better condition in which the currents from the dynamo can meet the disturbances arising from either the contact with wires conveying other dynamo currents used for illumination or for the transmission of power.

The Telephone Service between the different fire stations in Lynn has been unsatisfactory from the start. It is often the case that immediate communication is absolutely necessary between the firemen at the different houses in order to locate a fire or transmit an important message to the Chief Engineer. At times, when attempts have been made to obtain one of the lines, a statement has been received from the Central office that the line was in use, and even when it was open it has been found difficult to converse clearly. The committee on fire department have had the matter under consideration for several weeks, and it is probable that some improvement will be made in this direction immediately, and the houses connected by a metallic circuit. Private lines will be laid by the City Electrician. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, July 21, 1892.

Mr. J. Wallace, of Ansonia, was one of the welcome vistors in Chicago this week.

Mr. Charles D. Jenney, of the Jenney Electric Motor Company, of Indianapolis, Ind., was in Chicago on Tuesday closing an important contract in Jenney motors.

The Western Union Telegraph Company, of Chicago, is negotiating for a new building. The Phenix Building at Clark and Jackson streets is under consideration.

The Security Insulator is rapidly meeting with the approval of the trade in general and the Electric Appliance Company, which is general western agent for this specialty, reports a brisk sale.

The Morse Heat, Light and Power Company, a newly organized company of Chicago, has asked the Council for the privilege of laying conduits through the principal streets in the city.

Sioux City, Ia.—The 700-acre park adjoining the Big Sioux River, on the west side of the city, has been sold to Chicago parties together with eight miles of electric railway, for the sum of $600,000.

Mr. H. L. Lufkin, of the C. & C. Motor Company, met a few of his Chicago friends on Wednesday, while en route to St. Paul. Mr. Lufkin has been an unfortunate sufferer from rheumatism for some time, but now is able to be on his feet again.

A new company, with a capital of 250,000, is being organized by George Cutter for the purpose of manufacturing rheostats and electric heating devices. The company controls patents on imbedding wires in enamel, and will start factories both at Chicago and in the East.

The Ries Electric Specialty Company, of Baltimore, Md., has a small model of its induction electric railway system on exhibition in Chicago, where it is attracting much attention by its simplicity, successful operation and the entire absence of overhead wires. The slight comparative cost of installation is also a feature worthy of consideration.

Chicago, Ill.—The control of the Love Electric Traction Company, with a capital of $10,000,000, has passed into the hands of Philadelphia, Boston and Baltimore parties. The Love system is in operation on one of the branch lines of the North Chicago Street Railroad. The purchasers are supposed to hold a controlling interest in West and North Chicago Street Railroad stocks.

The Detroit Exposition for 1892.—Active preparations are being made for the exposition which is to open Aug. 23. The average attendance at these expositions has been about 500,000, and it is estimated it will be considerably increased this year. The Knights of Maccabees have taken 50,000 tickets. The permanent buildings and grounds cover a territory of 72 acres, and are located on the beautiful Detroit River, adjoining the city, and accessible by boat, railroad or the new electric railway system. The buildings are of unique design, and the main building is one of the largest in the world. The electrical department is expected to be one of the chief features of the exposition. Arrangements have been made with all traffic associations so that freight will be returned free of charge, providing that it has been prepaid to the grounds.

F. DE L.

CANADIAN NOTES.

OTTAWA, July 17, 1892.

Chatham, Ont.—New tenders have been called for the introduction of electric light into Chatham.

St. John, N. B.—Tenders are called for in connection with the extension of the Consolidated Electric Company's buildings in this city.

Port Stanley, Ont.—The St. Thomas Street Railway is talking of extending its system to Recreation Park and thence to Port Stanley.

Ottawa, Ont.—The first electric car trucks ever made in Canada are now being constructed by Mr. Latour, of this city. He is making them for the local electric car company.

Montreal.—The rumor is prevalent that Mr. Everreti is coming to Montreal at once to manage the Montreal Street Railway Company and commence building the electric line, Mr. Lusher to remain superintendent.

The Dominion Wire Manufacturing Company (limited) has shipped the first lot of its contract of 27 miles of pure copper trolley wire for the Toronto Street Railway. This is the first lot of trolley wire in mile lengths ever made in this country.

Galt, Ont.—The Bell Telephone Company offers to pay the town the sum of $200 per annum for the exclusive right to erect telephone lines in Galt for a fixed term of years. This offer is made with a view of shutting out the Farmer's Telephone Company which wishes to extend its lines to Galt.

Iroquois, Que.—The agreement between the town and P. Keefe for an electric light service has been signed. Mr. Keefe is to light the streets with 10 arc lights of 2,000 c. p. each for a term of one year. The lights are to burn from dark until midnight for 260 nights during the year. The corporation pays for the light $400 a year.

Mayor Champagne, of Hull, interviewed Mr. Soper, of this city, on Monday last, regarding the possibility of extending the electric street railway through Hull to the Gatineau Point village, since the construction of the new bridge across the Gatineau has now been decided upon. Mr. Soper promised to lay the matter before the next meeting of the board.

Brantford.—The street car drivers struck at Brantford last week, but their places were so speedily filled by new men that there was practically no interruption of traffic. The rails for the new electric service have been distributed along the route. The new street railway company has called for tenders for a system of electric cars to be put in the place of the present system of horse cars. Tenders will be received until July 20.

Nanamio, B. C.—A. Shaw, proprietor of the National Electric Light Works, has assigned to J. H. Simson for the benefit of his creditors. Shaw states that the liabilities of the electric light company are $35,000. He put $18,000 into the enterprise, which he is afraid he will now lose. The works, it is said, were running satisfactorily, and the debt was being lessened at the rate of $4,000 per year, after paying all running expenses.

A clever move in the fight for the new electric road franchise of Montreal was made by the street railway company last week. According to the city attorney's opinion the company has the right to use electricity under its present contract on the rails, and it proposes to avail itself of this. It will commence to change its present system into electricity on Monday. The trolley system will be used. The other tenderers threaten to take out injunctions against the street railway company, if it persists in its scheme.

The Toronto Street Railway Company has decided upon making a change in respect to the payment of its employés. At first it was proposed to pay the motor man and conductor a daily wage for ten hours' work of from $1.25 to $1,50, according to the length of service. It now proposes paying the men by the hour, commencing at 12½ cents and working up to 15 cents by the half cent each six months until the maximum is reached. The men will be reqired to work no longer than 60 hours each week, and men will be kept by the company to do extra work. The system of employing men is that three men are set apart for each car; they relieve each other during the day so that neither of the three work more than ten hours a day. F. L. J.

News of the Week.

THE TELEPHONE.

Saratoga Springs, N. Y.—Work on a new telephone line to Ballston has been commenced.

Butler, O.—A toll station will probably be established at Butler, and in that case a loop will be put in the Mt. Vernon & Mansfield telephone line.

New London, Conn.—The Southern New England Telephone Company has successfully laid the new cable between the mainland and Fisher's Island.

The Redwood Falls (Minn.) Telephone Company has been organized with a capital of $4,000. The poles are being rapidly set up between Redwood Falls and North Redwood.

Toledo, O.—An ordinance has been passed granting the Ohio Telephone and Telegraph Company, of Cincinnati, the right to construct and operate a telephone service in Toledo, and to erect poles in streets to be named in future legislation. The line will run from Akron through Norwalk, Fremont and Perrysburg to Toledo.

THE ELECTRIC LIGHT.

Oberlin, O., is soon to have the electric light.

L'Anse, Mich., will soon have electric lights.

Cannonsburg, Pa., wants an electric light plant.

Monticello, Ind., is soon to be lighted by electricity.

Havana, Ill.—The electric light plant is now in operation.

La Grange, Ind., is adding an incandescent plant to its arc light plant.

Cedartown, Ga.—The electric plant has been completed and the current turned on.

Tampico, Mex., is to be lighted by electricity. Mr. Luis G. Llorente has secured the franchise.

Pine Bluff, Ark.—Arrangements are being perfected for the erection of a new electric light plant.

Holbrook, Mass., is determined to have electric lights, and the question has been thoroughly agitated.

Edwardsville, Ill., has advertised for bids for electric lights. The bids must be made on or before Sept. 1.

Prospect, Ind.—Preparations are being made for an electric light plant which is to be finished by Aug. 1.

Tully, N. Y.—An effort is being made to introduce electricity into Tully, both for street lighting and private use.

The Evansville (Ind.) cotton mills are being equipped with a new electric plant, which is now nearly completed.

Rochelle, Ill.—Rochelle parties have purchased the electric light plant at Pecatonica, and will remove it to Rochelle.

Troy, N. Y.—Work has been begun on the foundation for the engine for the new station of the Troy Electric Light Company.

Pawtucket, R. I.—A slight fire occurred in the power house of the Narragansett Electric Company on the morning of July 17.

Laconia, N. H.—The new passenger station will be illuminated with electric lights from the railroad company's plant at Lakeport.

Spring Valley, Ill., is to have electric lights for its streets. The council has ordered a 30 lamp arc light plant to be put in at once.

Stamford, N. Y.—The electric light plant has been completed and the citizens celebrated the event of the turning on of the lights.

Moncton, N. B.—The Intercolonial Railway Company has decided to light its shops and yards by electricity. The Wood system has been adopted.

The Mohawk Valley Electric Light and Power Company, with headquarters at Palatine Bridge, N. Y., is negotiating for the construction of a dam.

The Lockhaven Electric Light and Power Company has purchased the interest of Ross Harris & Company in the new electric light plant on Corning street.

Rockville, Conn., will not accept the increased price of arc street lights which the electric company demands, and has voted to discontinue lighting the town by electricity.

Delavan, Ill.—The Royal Electric Eight and Power Company is making a one-story addition to its engine house in order to obtain sufficient room for a new engine and dynamo.

Perry, N. Y.—A new company called the Perry Electric Light Company has been organized and will soon be incorporated. It expects to have a plant in operation by September.

The Pennsylvania Railroad Company has decided to do its own lighting along its tracks between Pittsburgh and East Liberty. The construction of a large plant near Union Station has been begun.

Philadelphia, Pa.—The Board of Directors of the Edison Electric Light Company are discussing the question of increasing the plant on Sansom street, and the capital stock of the company from $500,000 to $1,000,000.

The Thomson-Houston Company, which recently purchased the plant of the Syracuse Electric Light and Power Company, intends to double the capacity of the plant. It will spend $200,000 in making the improvements.

Cincinnati, O.—The Morgan Electric Light Company is re organizing to supply light to Walnut Hills, Mount Auburn, Norwood and other suburbs. A power house will be erected at Walnut Hills with a capacity of 140,000 lights.

Bayonne, N. J.—An ordinance granting a franchise to the Bayonne Electric Light, Heat and Power Company, has been passed by the city council. An electric fire alarm system, valued at $5,000 is guaranteed to the city in consideration of the lighting contract.

The Ball Electric Light Company has received the contract for lighting the village of Hempstead, N. Y. The present contract expires on Oct. 15, and the Ball company agrees to have a new plant installed and the lights ready to turn on at that date. The village requires 60 arc lights.

The Logansport (Ind.) Electric Light and Power Company has purchased the entire local plant of the Jenney Electric Light and Power Company. Important improvements will be made in the near future, and a 1,000 light Slattery incandescent dynamo, a generator to furnish current for power, and a new boiler and engine will soon be added.

THE ELECTRIC RAILWAY.

The Lincoln City Electric Street Railway is reported to have been sold by the sheriff.

Greenville, N. Y.—Electric cars have taken the place of the horse cars on the line from Greenville to Taftsville.

Wauwatosa, Ill.—The Wauwatosa electric railway line has been opened, and cars are now making regular trips.

Buffalo, N. Y.—Electric cars are now running regularly on Ontario, Second and Falls streets, and the Schlosser dock line.

Saratoga, N. Y.—On July 15 a gale of wind destroyed the car house of the Saratoga electric road and wrecked eight cars, including two Pullman double-deckers. The damage is estimated at about $15,000.

New Haven, Conn.—The State Street & Whitney Avenue horse railroad has passed into the hands of New York and Boston capitalists, and it is understood that these lines will be equipped with electricity.

New Orleans, La.—Local capitalists acting with outside parties have made an effort to purchase and consolidate all the street railways in the city, involving a capital of some $10,000,000. It is proposed to operate all the lines by electricity.

Brooklyn, N. Y.—Mayor Boody has vetoed the resolution recently passed by the Board of Aldermen granting franchises for electric roads to the Union Railway Company and the Coney Island, Fort Hamilton & Brooklyn Railroad Company.

Livingston, N. Y.—Ground has been broken for the electric power company's plant which is to be erected at a cost of about $250,000. Only half of the proposed building is to be erected at the present time. This part will be 150 feet long and 110 feet wide, and will be divided into two rooms. Four 325-h. p. Babcock & Wilcox boilers and compound condensing engines will be installed.

New York.—A meeting was held last week at the Equitable Building, New York City, for the purpose of reaching some agreement between the elevated and surface roads of Brooklyn in regard to placing the trolley on the elevated structure. Mr. Uhlmann, of the Brooklyn Elevated; Vice-President Goodwin, of the Kings County Elevated; President Lewis, of the Brooklyn City Railroad, and William Richardson, of the Atlantic avenue road, were present. It is stated that a definite agreement was reached and will be ratified by which the surface roads were to pay the elevated roads a certain sum for the privilege of stringing their wires on the elevated structures.

LEGAL NOTES.

The Hart & Hegeman Manufacturing Company, of Hartford, Conn., has brought suit against H. T. Paiste, of Philadelphia, Pa., for infringement of patent on eccentric snap switches.

The Mather Electric Company, of Connecticut, has asked the United States Court at Boston for an injunction under the anti-trust statute against the General Electric Company, the Edison General Electric and the Thomson-Houston Electric, restraining their patents.

Cleveland, O.—The Circuit Ceurt has sent down a decision sustaining the demurrer to the petition in the case of Ohio *et al vs.* the Incandescent Light and Power Company, the *quo warranto* case begun some time ago by the old electric light company, wherein they denied the city's right to contract with the new company for street lighting. This decision confirms the city's right to contract as it did.

Philadelphia, Pa.—Robert Sturgis, ae referee, has filed his report in the Supreme Court in favor of the city of Philadelphia in its suit against the Bankers and Merchants' Telegraph Company and the Postal Cable Company, for license fees for the use of the city for telegraph poles. The amount of the judgment is $11,805. The Common Council of the city passed a resolution declaring that the maintenance of the wires of the companies in the streets was an inconvenience.

Withdrawal of Jamaica's Suit.—The village of Jamacia L. I., has withdrawn its action against the Jamaica & Brooklyn Street Railway Company, without costs. In June, 1890, the village trustees of Jamaica brought suit against the railroad to restrain it from laying a double track on Fulton street, Jamaica, from operating its line by electricity, and from collecting toll on the Jamaica plank road. The courts held that the only count in this action that could hold was the clause relative to the use of electricity. The State Commission afterward granted the company's request to use electricity.

The Electrical Construction Company, of Chicago, filed a bill in the Circuit Court yesterday against the New York Insulated Wire Company to compel the specific performance of a contract. Under the contract in controversy the complainant claims the right to wire and do the construction work on the electric incandescent lamps to be used at the World's Fair grounds. It is claimed that the defendant is violating the agreement by permitting the Westinghouse Electric and Manufacturing Company to do the work. An injunction is sought to restrain further work until the contract is adjusted.

PERSONALS.

Mr. H. Duront Cheever, the president and manager of the Okonite Company, Limited, has gone to Europe on a well-earned vacation. He will inspect the branch factories of the company in London.

Mr. H. L. Johnson, the secretary and treasurer of the Manhattan Electric Supply Company, 36 Cortlandt street, left with Mrs. Johnson on Tuesday of last week for a short visit to Del Norte, Colo.

MISCELLANEOUS NOTES.

New Haven, Conn.—An electric stamping machine has been introduced by the New Haven Post Office.

Manchester, N. H.—Merrill & Freeman have installed a 24-h. p. motor to furnish power for their grist mill.

Macon, Ga.—A company has been organized to dam the Ocmulgee River, erect a power house, and furnish Macon with power to the extent of about 6,000 h. p.

Sacramento, Cal.—Capitalists and electricians have been examining the water power of the American River, with reference to its utilization for supplying Sacramento with light and power.

The New Jersey & Pennsylvania Concentrating Works, at Paterson, N. J., Thos. A. Edison, president, has leased 100 acres of land in Upper Milford, and intends to extract ore by its electrical process.

Washington, D. C.—A bill has been introduced in the Senate, having already been before the House, granting to C. C. Moreno and associates the right to lay telegraph cables in the Pacific Ocean between the American and Asiatic coasts.

Electrocution on a Wholesale Scale.—During the recent thunder storm at the town of Zacatecas, in Mexico, three prisoners in the penitentiary were killed outright by a lightning bolt and 10 others were struck senseless, five of whom subsequently died; making eight people killed with one stroke.

Ball Bearings in Street Cars.—There has been running on the Fitchburg (Mass.) street railroad for several months a car mounted on ball bearings which have been in constant use and subjected to the severest tests, and it is claimed that there is no evidence of wear either on the bearing surfaces or the balls. The bearings were oiled at first with a few drops, but have not been touched since. The inventor claims a process of making perfect steel spheres, and of hardening them so that they will not break.

Industrial and Trade Notes.

The Heisler Electric Company has secured a contract for a new electric light plant at Deckerstown, N. J.

Julius Andrae, of Milwaukee, has made arrangements to represent the Central Electric Company in Milwaukee, and will carry a full stock.

The Ries Electric Specialty Company, of Baltimore, Md., is sending out a very attractive pamphlet telling all about the Ries Regulating Socket, "the missing link in electric lighting."

The General Electric Company has opened an office and storeroom for its railway department at 24 West street, New York, which is to be under the charge of Mr. H. H. Harrison.

The Silver Lake Association, of Silver Lake, N. Y., has an interesting little plant of 12 arc lights for illuminating the grove and buildings. It was installed by Putman, Gay & Co., of Rochester, N. Y.

Boston, Mass.—The copartnership heretofore existing under the style of Claflin & Kimball has been dissolved by mutual consent. The affairs of the firm will be settled and business continued by Claflin & Kimball, incorporated, a corporation organized under the laws of Massachusetts.

The Central Electric Company is meeting with success with the Acme lead cable manufactured by the Okonite company. This cable is substantially made, and for underground service, it is claimed, there is no better. It has been on the market now about a year, and instead of complaints it is praised wherever used.

J. H. Bunnell & Co., 76 Cortlandt street, New York, dealers in telegraph, telephone, electric light and railway supplies, have gotten out a very neat glass paper weight bearing the well known faces of J. H. Bunnell and Chas. McLaughlin. This company was founder in '73, so that it is no stranger to the electrical fraternity.

The Phœnix Automatic Filter Company, of Racine, Wis., has issued an instructive little pamphlet entitled "A Practical Treatise on Oil Filtration," which contains useful information, besides setting forth the merits of the Tracy Patent Oil Filter. This filter has many excellent points, and a great efficiency is claimed for it.

Putman, Gay & Co., of Rochester, N. Y., has secured the contract for equipping the Western New York State House of Refuge for Women at Albion, N. Y., with electric lights. The six large buildings are to be fitted throughout with interior conduit, manufactured by the Interior Couduit and Insulation Company of New York, for which Messrs. Putman, Gay & Co. are agents.

Widmer & Spranley, of New Orleans, in a recent communication, make the following statement: "Having this day bought out the interest of Mr. W. I. Mathews in the firm of Mathews, Widmer & Co., at No. 78 Customhouse street, the business will hereafter be conducted in the name of Widmer & Spranley. The new firm assumes all assets and liabilities of the old firm."

Gaston, Weston & Ladd, 41 Beekman street, New York, are meeting with good success with their well known polisher, Presto. line. This metal burnisher is manufactured from a scientific formula, and always in exactly the same proportions. It is made in both paste and liquid form. As it does not discolor or stain, it can be applied to wood as well as metal. It is claimed that it does not deteriorate in the slightest degree with age.

The Ohio Machine Tool Works, Cincinnati, O, has increased its line of manufacture, and is now making pulley lathes of improved design for the simultaneous boring and turning of pulleys, blank gears, etc. These machines will cut down both sides of a gear at one operation, while the diameter is being turned, and bore at the same time. The company can deliver at once machines of 25-inch and 30-inch swing and those of 36 inch and 60 inch on short notice.

The Consolidated Electric Manufacturing Company, of Boston, on account of pressure of business in specialties has been obliged to discontinue its retail store corner of Congress and Franklin streets, and has fitted up new offices at the factory, 353, 355 Congress street. The company has opened a branch office in Chicago under the charge of Mr. C. E. Spofford, formerly its New England agent. The company makes a specialty of the Heyman arc lamp for incandescent circuits, the Lyon brake handle, etc.

Honor to Whom Honor Is Due.—We are requested by Queen & Co., of Philadelphia, to mention that the cable testing keys illustrated in our issue of the 6th inst., were suggested to them by E. W. Stevenson, electrician of the Brush Electric Illuminating Company, of New York. Mr. Stevenson has had wide experience in such matters, and hence, knows probably as well as any one what the actual requirements are. He has used a set of keys similar to those of Queen & Co. for some time past with very satisfactory results.

The Purity Oil Filter Manufacturing Company, of Pittsburgh, Pa., reports the following July sales: The Martin Cantine Company, Saugerties, N. Y.; Glens Falls, (N. Y.) Paper Mills Company; Doylestown, (Pa.) Electric Company; Yonkers, (N. Y.) Electric Railroad Company; New York Hospital for Insane Criminals, Fishkill Landing, N. Y.; J. C. Hubinger Company, Keokuk, Ia.; Metropolitan Street Railway, San Francisco, Cal.; Silver Bow Electric Lighting Company, Butte, Mont.; Metropolitan Street Railway Company, Macon, Ga.; Industrial Works, Bay City, Mich., and other sales including Boult Bros., Liverpool, Eng. representing Leonard & Ellis Oil Company, of New York. This firm will also represent the Purity Oil Filter Manufacturing Company in Great Britain.

Sturtevant Fans and Blowers.—The B. F. Sturtevant Company, of Boston, Mass., has shipped a three-room lumber drying apparatus to Chili, South America. This company was recently in receipt of an order for an apparatus for six standard kiln rooms, from the Russian government. Seven car loads of apparatus have been shipped since Feb. 1 to Oregon and Washington, most of which have been used for drying shingles. Seven large fans have been recently shipped to Bolivia, South America, for use in one of the largest silver mines in the world. Four of these are driven by the Sturtevant double inclosed steam engines, two of them by the Sturtevant compound steam engines, and one by a Sturtevant electric motor, all direct attached. This electric fan is constructed so as to hang from a rope in the mine shaft. Recent large orders have been received from Cuba, Mexico and other foreign countries, showing that the reputation of the Sturtevant goods is world-wide.

The Ball Engine Company reports the following among the sales during the past six weeks: Prohibition Park Railway Company, Port Richmond, one 150-h. p. engine; F. O. Matthiessen, Chairman Manufacturing Commercial American Sugar Refining Company, two 100-h. p.; Baltimore Traction Company, Baltimore, Md., two 130-h. p. heavy duty engines; F. H. Beggett & Co., New York City, one 50-h. p.; Metropolitan Telephone and Telegraph Company, New York City, one 60-h. p.; Brokaw Bros., New York City, two 150-h. p. and one 80-h. p.; H. Ward Leonard & Co., New York City, one 150-h. p.; Curtis & Dean, New York City, one 60-h. p.; Royal Light, Heat and Power Company, Front Royal, Va., one complete steam plant, 100-h. p. engine, and 125-h. p. boiler; Hot Springs Electric Company, Hot Springs, Va., one complete steam plant, 100-h. p. engine, and two 80-h. p. boilers; for Guantanamo, Cuba, one 80-h. p. engine; C. S. Furst, Newark avenue, Jersey City N. J., one 50-h. p. engine, one 80-h. p. boiler; Navy Yard, Brooklyn, N. Y., two 80-h. p. engines; Buffalo Board of Trade, Buffalo, N. Y., one 60-h. p. engine.

The Crocker-Wheeler Electric Company has completed an important arrangement whereby The Electrical Supply Company, corner Randolph street and Michigan avenue, Chicago, Ill., becomes sole agent for Chicago and distributing agent for the territory covered by its large force of traveling men. Mr. H. C. Hutchison, who for two years past has been manager of the motor department for the Edison General Electric Company, Chicago, will have charge of the Crocker-Wheeler department for The Electrical Supply Company. He is now fitting up a large and handsome exhibit at The Electrical Supply Company's building, comprising motors, generators, pumps, stationary and revolving fans, hat ironers, organ and sewing machine attachments, exhaust and suction fans, and many other Crocker-Wheeler novelties. This combination accounts for the frequent visits to Chicago of Mr. George W. LaRue, general sales agent of the Crocker-Wheeler Electric Company, who conducted the above negotiations. Mr. LaRue has established Crocker-Wheeler agencies all over the United States and reports the business of his company as something phenomenal.

Inquiries from Correspondents.

Queries to be inserted in this column must be of general electrical interest, and must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. No notice will be taken of questions which involve nothing more than can be found in elementary treatises on the subject. All correspondence should be as brief as is consistent with clearness. Readers are invited to send discussions and answers to these questions.

[122.] Would it be possible or practicable to connect a motor between the trolley and the ground of a street railway system?

J. K. S. R.

Answers to Correspondents.

Readers are invited to send discussions regarding, or answers to the queries published in Inquiries from Correspondents or with regard to any other live questions on electrical subjects. In answering questions please refer to them by their serial number. Correspondence must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. Names of correspondents will be printed in full unless otherwise requested. All correspondence should be as brief as is consistent with clearness. THE ELECTRICAL WORLD *assumes no responsibility for the opinions expressed by correspondents.*

[120] It is to be presumed that by a chloride of silver dry battery the ordinary chloride of silver cell is meant, the term dry being applied to it from the fact that, unlike most other cells, it can be hermetically sealed. The elements are zinc and silver, chloride of silver being cast on the silver. The chloride is easily melted in a porcelain crucible, and may be cast on a silver wire in a hard carbon mold. The zinc and the silver wire are sealed by means of a paraffin stopper into an ordinary test tube containing a solution of ammonium chloride of a strength obtained by dissolving twenty-three grains of sal-ammoniac in two pints (one litre) of pure water. The initial electromotive force of this cell is about 1.1 volts.

W. H.

[121] No particular provision is made for overcoming the increased bearing friction caused by the attraction at the bearings of an Edison generator due to the magnetic leakage through the bearings, for the reason that the pressure arising from this cause is so slight as to be scarcely appreciable.

A. B.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

An Indispensable Companion for Every Electrical Student.—Mr. K. K. Kennan, general manager of the Gothenburg (Neb.), Water Power and Investment Company, states the following regarding Houston's "Dictionary of Electrical Words, Terms and Phrases;" "Having carefully examined 'Houston's Dictionary,' I beg to say that it seems to answer every reasonable requirement for such a book and to be an indispensable companion for every careful electrical student."

Pullman Vestibuled Buffet Sleeping Car Service—Chicago to Portland, Me.—Commencing June 26, and continuing through the tourist season, the Chicago & Grand Trunk Railway

will run a Pullman vestibuled buffet sleeping car of the most modern pattern, through without change, from Chicago to Portland, via Toronto and Montreal, leaving Chicago 3 P. M. daily except Saturday, arriving at Portland for breakfast second morning. On this train there will be a Pullman car for Old Orchard Beach, and tourists for all North Atlantic seaside and mountain resorts will find this improved through service worthy of patronage. Secure sleeping car reservations and further information by applying to E. H. Hughes, General Western Passenger Agent, No. 103 S. Clark street, Chicago.

Two Harvest Excursions--Half Rates to the West.—August 30 and September 27—on these dates the Burlington Route will sell tickets from Chicago, Peoria and St. Louis to the farming districts of Nebraska, Colorado and Northern Kansas. Half rates will apply, and tickets will be good for 20 days. Nebraska in one year produced 330,000,000 bushels of corn, besides other grain, fruits and live stock. Write for free pamphlets, etc., to P. S. Eustis, G. P. A., Burlington Route, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED JULY 19, 1892.

479,007. Electric-Arc Lamp; Maurice S. Logan, Otterville, Mo. Application filed Aug. 29, 1891. In an electric-arc lamp, a carbon feed rod or carbon holding rod provided with means for holding the carbon in a collateral position therewith, and also provided with means by which the carbon travels thereon in a longitudional direction.

479,017. Hanger for Electric-Arc Lamps; Charles A. Pfluger, Chicago, Ill. Application filed Jan. 23, 1891. In a hanger for an electric-arc lamp, the combination of a movable portion carrying a hook adapted by the movement of such portion to be cut in or out of the main circuit with a suspending-loop on the lamp, adapted to engage the hook and a cam, whereby the two are disengaged when the lamp is to be lowered, the same cam fixed in position, a pin on the hanger to be engaged by this cam.

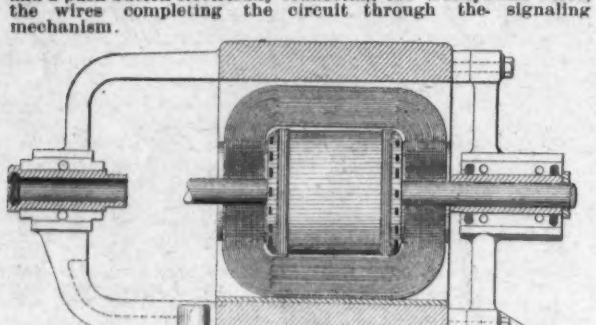
479,020. Incandescent Electric Lamp; Max A. Richter and James G. Nolen, Chicago, Ill. Application filed Feb. 10, 1892. A combined incandescent electric lamp and moisture-shedding shade comprising the bulb and an imperforate concavo-convex shade, one of the said members being provided with a socket formed directly in the material of which it is composed and the other member being formed with a neck of the same material as the body of the member and fitted and cemented within the socke .

479,029. Electric Arc Lamp; Elmer A. Sperry, Chicago, Ill. Application filed April 18, 1890. In an electric arc lamp, the combination of a spring-supported frame with a shunt magnet, a lever on which the frame rests, and a cut out magnet, a lever normally open, and an angularly bent rod, one end of which is attached to a lever by which the cu-out magnet can be closed and the other placed in proximity to a moving portion of the spring-supported frame of the shunt magnet lever.

479,030. Armature for Electric Machines; Elmer A. Sperry, Chicago, Ill. Application filed Dec. 17, 1891. In an armature for electric machines whereof the core is made up of thin rings or discs insulated from each other, a thicker ring or disc on the end of the core, having axially extending projections secured thereto, in combination with tie-bolts passing through the projections and insulated therefrom.

479,035. Safety Device for Electric Circuits; Mandeville Thum, Louisville, Ky. Application filed June 5, 1891. The combination, with a conductor to be guarded, of a second or guard conductor constituting a part of an electric circuit, a safety device in the circuit adapted to effect a change in the guarded circuit, a source of electrical energy for the circuit separate from the generator of the guarded circuit, and normally open circuit-closing devices between the conductors.

479,046. Electric Signal for Mine Shafts; Frederick W. Bacorm, Marysville, Mont. Application filed Feb. 27, 1892. The combination with a mine shaft and an electric wire therein extending through its length, electrically open at its lower end and connected at its upper end with signaling mechanism, and a cage provided with a trolley on said wire, of a second open wire extending through the length of the shaft and a trolley thereon; and a push button electrically connecting the trolleys and wires, the wires completing the circuit through the signaling mechanism.



No. 479,118.—Dynamo Electric Machine.

479,062. Speaking Attachment for Telephones; Daniel Eldredge, Boston, Mass. Application filed Feb. 26, 1892. A telephone transmitter and stationary support therefor, combined with a flexible speaking tube, having an end piece at one end, comprising a cap of suitable size and shape to abut against the face of the transmitter and completely inclose the speaking orifice thereof, a yielding pad having a hole through it interposed between the cap and the face of the transmitter, and a retaining device for holding the cap firmly abutted against the face of the transmitter, and an end piece at the opposite or outer end of the speaking tube, provided with a mouthpiece and a swinging support for the outer end of the speaking tube.

479,101. Rheostat; John Waring, Manchester, Conn. Application filed April 28, 1892. A resistance box consisting of a base with an insulating slab, bearing binding screws, switches, coils and contacts with bridges movably supported above the contacts and held by a counter-balance, the bridges being provided with a stop whereby they may be held depressed.

479,107. Telephone-Switchboard; Wilhelm Oesterreich, Berlin, Germany. Application filed Aug. 7, 1889. In multiple switch boards, a jackswitch comprising a switch body, one end of which is tubular, and a contact spring having a V-shaped portion and being secured to but insulated from the switch body in such a manner that the free end of the spring will nominally contact with the tubular portion of a switch body, and a telephone line electrically connecting the switchbody of one jackswitch with the contact spring of the next jackswitch throughout the series of the same telephone line, in combination with a test battery interposed in the ground connections of the terminal switch of a series of such.

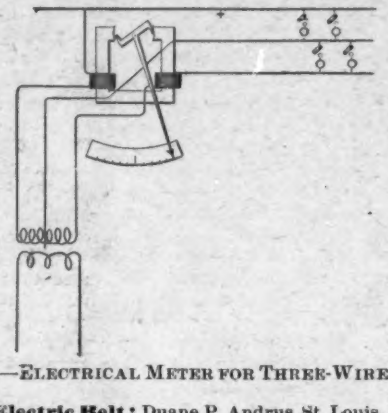
479,118. Dynamo-Electric Machine; Rudolf Eickemeyer, Yonkers, N. Y. Application filed Dec. 21, 188-. In a dynamo-electric machine, the combination, with a cylindrical or drum armature having an iron core and field coils surrounding the armature longitudinally, of a casing or shell surrounding the field coils and armature, composed of solid, seamless soft-iron plates, each continuous in a plane at right angles to the axis of the armature. (See illustration.)

479,121. Electric Arc Lamp; William E. Irish, Chicago, Ill. Application filed Jan. 2, 1892. In an arc lamp, means for controlling automatically the movement of the upper electrode, consisting of the combination of a tube surrounding loosely the electrode, outwardly projecting flanges surrounding and attached to the tube at the upper and lower ends, springs resisting the upward movement of the flanges, an operating pivoted lever upon which one of the flanges rests, and a thermo-expansive electric conductor and actuating spring connected with and controlling the lever.

479,134. Insulator; Chauncey Eugene Conover, Cincinnati, O. Application filed Jan. 20, 1892. An insulator consisting of a main body having a hole longitudinally through its centre for securing it with a nail or screw to a fixed object, and being provided at one side of the fastening hole and in a plane at right angles therewith, with a line wire groove or seat, and having also, in the same plane therewith and encircling the main body, a tie-wire groove arranged diagonally with the line wire groove or seat and leading thereto, and ears, one at each end of the diagonal groove, and above the line wire groove or seat, for retaining the line wire.

479,138. Signal for Electric Railways; Frank F. Loomis, Akron, O. Application filed April 8, 1892. In a signaling system for electric railways, a series of boxes, each having an electromagnet pivoted to rock vertically, combined with two oppositely disposed fixed electromagnets, the core of each pivoted magnet arranged to rock between the cores of the fixed magnets of its box, each rocking magnet connected with the source of electrical energy in the same direction and each having a ground wire, the fixed magnets being connected in converse directions with the source, the boxes being electrically connected to permit their several magnets to be energized, and signaling devices arranged to be actuated by the rocking magnets.

479,139. Thimble for Light Fixtures; John J. Miller, Pittsburgh, Pa. Application filed April 6, 1892. A thimble for light fixtures, having in combination a cup-like shell adapted to be embedded in a wall or partition and provided with openings in its walls for the insertion of electric wires, a nipple projecting into the shell for connection with a fixture and means for securing the shell in the wall.



No. 479,168.—Electrical Meter for Three-Wire Systems.

479,147. Electric Belt; Duane P. Andrus, St. Louis, Mo. Application filed Dec. 14, 1891. An electric belt having a pocket or pockets adapted to move upon the belt, a battery placed within the same, conducting cords leading from the positive and negative poles of the battery, an electrode or electrodes electrically connected with the opposite end of the connecting cord and a U-shaped wire or wires attached to the concave surface of the electrode.

479,167. Electrical Meter; Arthur E. Kennelly, Orange, N. J. Application filed Oct. 17, 1891. The combination, with a continuous current circuit, of a meter comprising an indicating mechanism, an electric motor for driving it, the armature of the motor having a working coil connected to the circuit, a closed idle coil or conductor serving to put a load on the motor, and a field magnet coil connected to the same circuit.

479,168. Electric Meter for Three-Wire System; Arthur E. Kennelly and John F. Ott, Orange, N. J. Application filed Oct. 21, 1891. The combination, in a meter adapted for alternating current systems, of a laminated core, co-operating coils thereon, each coil being connected or adapted to be connected to a separate main, an armature, and an indicating device moved thereby. (See illustration.)

479,169. Electro-Magnetic Machine; Arthur E. Kennelly and John F. Ott, Orange, N. J. Application filed Oct. 21, 1891. The combination, in a magnet, of a main body and a laminated pole-piece, the pole piece and body being secured together by a strap passing around the pole piece and fastened to the body.

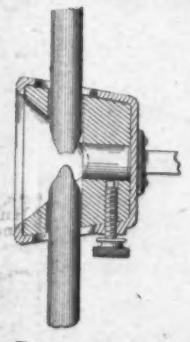
479,170. Compound Wound Alternating Current Dynamo; Herman Lemp, Lynn, Mass. Application filed Oct. 17, 1889. In an alternating current dynamo, the combination, with a field magnet circuit and an alternating current work circuit, of two armatures or armature coils connected in series through the field magnet coil, a commutator in such series circuit, a cross connection at an uncommuted portion of the circuit, and a reactive coil or resistance in such connection.

479,171. Electric Meter; John F. Ott and Arthur E. Kennelly, Orange, N. J. Application filed Sept. 7, 1891. The combination, in an electrical meter, of a recorder, a motor mechanism adapted to advance the recorder when in engagement, a cam for throwing the same into engagement at intervals, and a tripping device consisting of a pointer moved in one direction by the coil through which the current to be measured passes and moved in the opposite direction by the motor, and a retracting lever moved by the pointer.

479,172. Electric Current Meter; John F. Ott and Arthur E. Kennelly, Orange, N. J. Application filed Nov. 30, 1891. The combination in an electric meter, of a recording device, a regulated motor for advancing the recording device when in engagement, means for throwing the same into engagement at regular intervals, comprising suitable levers, springs adapted to move the levers forward, and regularly moving cams for putting the springs under tension and then releasing them, and a trip or disengaging device controlled by the current being recorded.

479,178. Telegraphic Repeater; Roderick H. Weiney, New York. Application filed Feb. 8, 1892. In a telegraphic repeater, the combination, with the armature of the main receiving magnet, of an independent differential electromagnet, a local battery, and a breaking point included in the circuit of one winding of the differential magnet, which is brought into action before the circuit of the main magnet is broken.

479,179. Armature for Dynamo-Electric Machines; Merle J. Wightman, Scranton, Pa. Application filed Oct. 28, 1891. In an armature, flexible lead wires attached directly to the armature winding and bound down or clamped against vibration at the point of attachment by the armature windings.



No. 479,183.—Reflector for Arc Lights.

479,183. Reflector for Arc Lights; Robert S. Dobbie, Brooklyn, N. Y. Application filed April 8, 1891. The combination, with a hollow refractory body having a socket, of lamp carbons forming an arc within the body, a refractory block in the socket and near the arc, adapted to become incandescent, and means for securing the block and adjusting the same. (See illustration.)

479,184. Fac-Simile Telegraph; Thomas A. Edison, Menlo Park, N. J., and Patrick Kenny, New York. Application filed Dec. 6, 1881. A fac-simile telegraph having transmitting and receiving instruments, the transmitting circuit being controlled by the depressions produced by making autographically upon paper or other material. (See illustration.)

479,187. Alternating-Current Motor; Thomas H. Hicks, Detroit, Mich. Application filed March 9, 1891. The combination, with an alternating-current motor, of a converter having its primary coil in circuit with the armature of the motor, and a part of the secondary coils in circuit with the field magnet coils of the motor through a commutating or current-shifting device, rotatable with the armature.

479,216. Clamp for Electric Conductors; John Ingmanson and Rudolph Loring, Chicago, Ill. Application filed July 13, 1891. In a clamp for electrical conductors, the combination of a pair of jaws, a tongue projecting laterally from each, said tongues being presented in opposite directions, and means for locking the jaws against relative longitudinal movement.

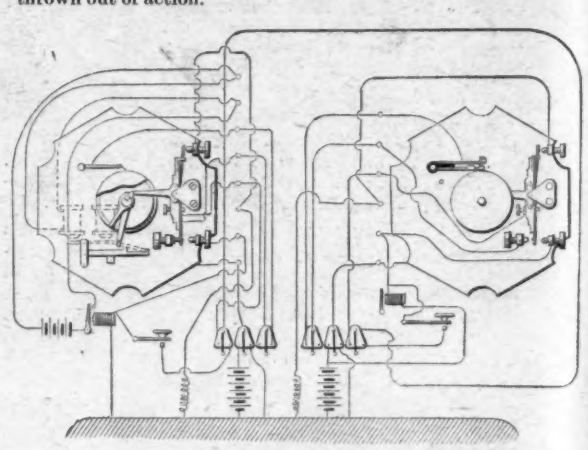
479,225. Switch and Signal Apparatus; Jens G. Schreuder, Edgewood, Pa. Application filed Jan. 20, 1892. In a switch and signal apparatus, the combination of movable switch-rails, a fluid pressure mechanism for locking such rails in position for clear main line, electrically operated valves controlling the flow of fluid pressure to and from the mechanism, a normally-closed circuit controlling the valves and provided with a circuit breaker, and a signal controlling a track section adjacent to the switch and adapted when shifted to "danger" to open the valve-controlling circuit, and thereby so shifting the valves as to effect a locking of the switch rails to clear the main line.

479,226. Telephone; George F. Shaver, Yonkers, N. Y. Application filed March 2, 1892. In a telephone receiver, the combination of one or more magnets, each forming an incomplete ring and having pole pieces extending into the ring, the magnets being reversed and laid one upon the other with a diaphragm adjacent to the pole pieces.

479,227. Telephony; George F. Shaver, Yonkers, N. Y. Application filed April 8 1892. The method of transmitting two distinct sounds over single conductor simultaneously by causing electrical undulations similar in form to the vibrations of the air accompanying one of the sounds and mechanical vibrations similar in form to the vibrations of the air accompanying the other of the two sounds.

479,282. Electric Alarm; Robert Lowry Keith, Brazil, Ind. Application filed May 26, 1892. In an electric alarm for the detection of poisons, the combination, in a circuit, of a battery, an alarm, and a wire connecting the battery and alarm with a shell, a metal rod constituting part of the circuit and carrying one or more spring levers, each lever provided with a projection extending through the shelf, and one or more bottles, each adapted to rest on one of the projections, whereby on the removal of a bottle from one of the projections the circuit is closed by the action of the lever and the alarm sounded.

479,308. Individual Alarm Signal Apparatus; Paul Seiler, San Francisco, Cal. Application filed Aug. 1, 1891. A return disc with projecting pins, a lever and clock train, an escapement and controlling electromagnet by which the disc is advanced one interval at each movement of the armature a second magnet with an armature which actuates a stop engaging the pins at each movement, and a connection from the circuit wires through one of the pins, whereby a short circuit is established through this pin and the stop when they are in contact and the magnet is thrown out of action.



No. 479,184.—Facsimile Telegraph.

479,321. Electric Brush; Robert E. Williams, Dallas, Tex. Application filed Jan. 2, 1892. A galvanic battery for an electric brush, comprising a trough divided into a series of cells by transverse partitions having notches in their upper edges, the cent metal plates seated in the notches, the battery elements contacting with the plates, and the conductor in the ends of the trough.

479,322. Connector for Electric Circuits; John F. Wollensak, Chicago, Ill. Application filed April 26, 1892. In electric circuit connector, the combination of an insulating piece secured to a face plate and provided with two sockets, the plate having holes registering with the sockets, contact springs secured to the insulated piece and communicating with the sockets through openings in the sides.

479,325. Connector for Electric Circuits; William E. Gill, Chicago, Ill. Application filed April 26, 1892. In electric circuit connectors, the combination of a portable block into which the ends of circuit wires are led, and stems, one within the other, fastening the ends of the circuit wires in the block, with the inner stem projecting beyond the outer and forming portable terminals.

479,327. Conduit Trolley for Street Cars; Arthur H. Heatsman, Baltimore, Md. Application filed March 24, 1891. In combination, a housing having brackets, insulators secured to these brackets, an inverted V-shaped conductor properly secured to the insulators, and a conductor secured to these supports.

479,333. Electric Railway Signal; Theodore A. B. Putnam, New York. Application filed April 15, 1889. The combination, with a locomotive, of a partial electric circuit thereon, a current generator in the circuit, and two conducting terminals for the circuit in contact with the rail, whereby normally the circuit is closed through the rail between the terminals, and a circuit breaking lever carried by the locomotive and adapted when displaced by contact with some provision on the track to break or increase the resistance of the circuit.

479,359. Incandescent Lamp Socket; Isaac Goldkind, New York. Application filed Dec. 15, 1891. The combination, with a socket having electrical conductors, of a rotary spindle arranged between the conductors, a block on the spindle adapted to engage or release the conductors, a ratchet wheel on the spindle, a check pawl engaging the ratchet wheel, a sleeve mounted loosely on the spindle, a lever attached to the sleeve, a helical spring acting on the lever and sleeve, and a clutch device between the sleeve and spindle.

479,360. Incandescent Electric Lamp; Henry Green, Hartford, Conn. Application filed Sept. 2, 1891. In an incandescent electric lamp, the combination of a bulb, a seal connected to the neck of the bulb and comprising the body and the depending legs, the leading-in tubes incased in the body and depending legs of the seal, glass cores or fillings in the leading-in tubes, the filaments within the lamp having its ends secured in the lower ends of the tubes, and the wires secured in the upper ends of the tubes.

479,396. Cast Joint for Armored Conductors; Frederick M. Bennett, New York. Application filed March 28, 1890. As a means for uniting cables at an angle to each other, a cylindrical box having a drum provided with end pieces fitting the coupling of the cables and a joint for the reception of the exposed ends of the conductors of the cables.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1880—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.